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The Engineer.

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VOL. CXXXVII.—No. 3569] LONDON: FRIDAY EVENING, MAY 23, 1924 [PRICE {WITH SUPPLEMENT} ONE SHILLING BY INLAND POST 1s. 3d.

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

Single Reduction Turbines of the Orient Liner Orama (With a Two-Page Supplement).

The British Empire Exhibition (Fifth Notice).

Institution of Mechanical Engineers.

Experiments with Diesel Engines.

International Shipping Conference.

The Flow of Steam through Nozzles.

Iron and Steel Institute—No. II.

25-Ton Jib Crane for Swansea.

A New Electric Telemeter.

The Engineering Industries.

PUBLIC NOTICES

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for—
1. COMPOUND SURFACE CONDENSING ENGINES and BOILERS for Single-screw Launches.
2. MILD STEEL PLATES and SHEETS.
3. OPEN LINK and SHORT LINK CHAIN and CHAIN CABLE.

Tenders due on the 12th June, 1924, for No. 1, and on the 13th June, 1924, for Nos. 2 and 3. Tender forms obtainable from above. 5837

Architectural Draughtsmen REQUIRED for temporary employment in Government Departments. Candidates must have served in H.M. Forces during the war, have had good training in Civil Engineers' or Architects' Offices, and be fully capable of Preparing Working Drawings and Specifications for General Civil Engineering or Architectural Work. Salary, according to qualifications, but not exceeding £275 per annum.—Written applications, with full details of experience and qualifications, should be addressed to the JOINT SUBSTITUTION BOARD (Treasury and Ministry of Labour), Montagu House, Whitehall, S.W. 1. Replies will be sent only to such candidates as appear prima facie suitable for interview. 5785

Civil Engineers (4) REQUIRED by the GOVERNMENT of CEYLON for appointment as IRRIGATION ENGINEERS for three years in the first instance. Salary £500, rising to £900 a year by annual increments of £40 (£800 on attaining 30 years of age). Free passage provided. Candidates, 26 to 31 years of age, unmarried, must have had war service and passed the examinations to qualify for Associate Membership of the Institution of Civil Engineers or hold equivalent professional qualifications, and have had at least three years' practical experience on waterworks, drainage, or harbour and dock works.—Apply at once in writing, giving age and brief details of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting at head of application M/12,453. 5828

Engineers Required by the GOVERNMENT of BRITISH GUIANA for two years' service. Free passages.

M/12,760.—(Engineer).—Candidates, not over 45 years of age, must be fully qualified Civil Engineers, who have had extensive experience in charge of Water and Well-boring Operations. Salary £1000.

M/12,761 (Engineer).—Candidates, not over 45 years of age, must be fully qualified Civil Engineers, with experience in the Erection of Concrete Sluice Aqueducts and the laying of Foundations for the Erection of Pumping Plant. Salary £750 a year.

M/12,762 (Mechanical Engineer).—Candidates, not over 45 years of age, must be fully qualified Mechanical Engineers, with experience in the Erection of Crude Oil Engines. Considerable experience in Internal Combustion Engines essential. Salary £750 a year.

Apply at once, by letter, quoting clearly at head of application the reference number of the vacancy applied for, stating age, whether married or single, and giving brief details of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London S.W. 1. 5780

G. R.

BY DIRECTION OF THE SURPLUS STORES, &c., LIQUIDATION DEPARTMENT, TREASURY,

The Department would Draw THE ATTENTION OF MANUFACTURERS, ENGINEERS AND ALL OTHERS SEEKING FACTORY PREMISES, to the fact that they have for disposal

FACTORY PREMISES in certain INDUSTRIAL AREAS OF ENGLAND AND SCOTLAND suitable for the establishment of ENGINEERING WORKS, CHEMICAL WORKS, WORKS OR MILLS REQUIRING A PLENTIFUL WATER SUPPLY, and WORKS FOR LIGHT OR HEAVY MANUFACTURE.

The floor space varies from 4,000 square feet to 500,000 square feet, and most of the Factories have RAILWAY FACILITIES and some have CANAL and RIVER FRONTAGES.

Also FREEHOLD FACTORY SITES FOR SALE with areas varying from 5 to 200 ACRES.

Will applicants state their specific requirements and apply for full particulars to The Chief Valuer, Surplus Stores, &c., Liquidation Department, Treasury, Room 280, Caxton House, Tothill Street, London, S.W. 1. 5584

Technical College, BRADFORD.

APPLICATIONS are INVITED for APPOINTMENT as HEAD of the BUILDING and CIVIL ENGINEERING DEPARTMENT in the COLLEGE.

Commencing salary (in accordance with Burnham Scale), £800 per annum.

Full particulars of the appointment and forms of application may be obtained from the Principal of the College. Applications should be sent to me not later than 9th June.

N. L. FLEMING, Town Clerk.
20th May, 1924. 5805

Borough of Hemel Hempsted. SALE OF STEAM ROLLER.

TENDERS are INVITED for the PURCHASE of a 12½-TON AVELING and PORTER ROLLER, No. 5500, and SCARIFIER.

Form of Tender may be obtained from the undersigned and must be delivered not later than the 20th instant.

The Corporation does not bind itself to accept the highest or any Tender.

WALTER R. LOCKE, Borough Surveyor.
Hemel Hempsted.
19th May, 1924. 5818

Metropolitan Water Board. TENDER FOR THE SUPPLY OF 60in. STEEL PIPES AND SPECIALS, WALTON PUMPING STATION EXTENSION.

The Metropolitan Water Board invite TENDERS for the SUPPLY and DELIVERY of THIRTEEN STEEL PIPES and SPECIALS required for the 60in. Suction Main at their Walton Pumping Station.

Forms of Tender, specifications, bills of quantities, together with drawings, may be obtained from the Chief Engineer, Metropolitan Water Board, New River Head, 173, Rosebery-avenue, E.C. 1, by personal application (Room 155), or upon forwarding a stamped addressed brief envelope.

Tenders must be on the official forms, enclosed in sealed envelopes, and addressed to "The Clerk of the Board, Metropolitan Water Board, New River Head, 173, Rosebery-avenue, E.C. 1," endorsed "Tender for Steel Pipes, Walton," and delivered at the offices of the Board not later than 11 a.m. on Tuesday, 10th June, 1924.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER, Clerk of the Board.
Offices of the Board,
New River Head,
173, Rosebery-avenue, E.C. 1,
17th May, 1924. 5792

Salford Union. UNION INFIRMARY, PENDLETON, NEAR MANCHESTER.

RE-ADVERTISED, DUE TO DEATH OF CONTRACTORS' PRINCIPAL.

The Salford Board of Guardians invite TENDERS for HEATING and HOT WATER SERVICE APPARATUS, including Calorifiers, Pumps, Mains, Radiators, and the like, for above Infirmary and Nurses' Homes Extension.

Drawings of the plant may be inspected at the offices of the Engineer, Mr. T. Roland Wollaston, M.I.M.E., Lord's Chambers, 26, Corporation-street, Manchester, on or after May 19th, between the hours of 10 a.m. and 4 p.m. Specification, schedule of quantities, form of Tender and conditions of contract, may be obtained from the undersigned on receipt of written application, enclosing cheque value Two Guineas, which sum will be refunded on due receipt of bona fide Tender.

The Board do not bind themselves to accept the lowest or any Tender. The selected contractor will be required to subscribe to the conditions as regards employment of labour, &c., as set forth in the Board's regulations.

Sealed Tenders, endorsed "Engineering Section 2," must be delivered at my offices not later than 10 a.m. on Saturday, June 14th, 1924.

By Order,
E. H. INCHLEY, Clerk to the Guardians.

Poor Law Offices,
Eccles New-road, Salford,
13th May, 1924. 5756

State Electricity Commission OF VICTORIA.

MELBOURNE, VICTORIA, AUSTRALIA.

TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following for the Morwell Power Scheme.

Copies of Tender form and specification will be available upon application to:—
Agent-General for Victoria,
Melbourne-place, Strand,
London, W.C. 2.

SPECIFICATION No. 24/45.—66,000-VOLT INSULATORS.

CHARGE.—£2 2s. for the first three copies of Tender form, conditions of contract and specification complete. This charge will be returned on receipt of a bona fide Tender. A fourth copy and any further copies will be supplied for the sum of 10s. 6d. each. This charge is not returnable.

PRELIMINARY DEPOSIT.—A preliminary deposit of £50 is to be lodged with Tender.

The specifications may be inspected at the above-mentioned office.

The Commission does not bind itself to accept the lowest or any Tender.

Tenders, on prescribed forms, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than 5 p.m., 4th August, 1924.

R. LIDDELOW, Secretary.
5811

The Madras and Southern MAHRATTA RAILWAY COMPANY, LTD.

The Directors are prepared to receive TENDERS for:—

GIRDER BRIDGES, comprising 93 DECK SPANS of 30ft. and 1 DECK SPAN of 7ft. 6in. clear. Total approximate tonnage equals 460 tons,

according to the specification, which may be seen at the offices of the Company. The charge for the specification is One Guinea, which will not be returned.

Tenders must be sent in, addressed to the SECRETARY, not later than 3 p.m. on Tuesday, 17th June, 1924, and marked "Tender for Girder Bridges."

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices:
25, Buckingham Palace-road,
Westminster, S.W. 1.
19th May, 1924. 5815

The South Indian Railway Company, Limited, are prepared to receive TENDERS for the SUPPLY of:—
1. BUFFERS.
2. MISCELLANEOUS ARTICLES.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tenders for Buffers," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 13th June, 1924.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of each specification.

Copies of the drawings may be obtained at the offices of Messrs. Robert White and Partners, Consulting Engineers to the Company, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD, Managing Director.
91, Petty France, S.W. 1,
20th May, 1924. 5830

PUBLIC NOTICES

Felixstowe Urban District COUNCIL.

The Urban District Council of Felixstowe invite TENDERS for the MANUFACTURE, SUPPLY, DELIVERY, and ERECTION on site of:—
(A) CABLES.
(B) TRANSFORMERS.
(C) CONVERTER SETS.
(D) SWITCHGEAR.

Specifications and forms of Tender may be obtained on application to the Consulting Engineer, Mr. R. P. Wilson, Aldwych House (7th Floor), Aldwych, W.C. 2, on payment of a deposit of £2 for each section.

The model general conditions issued by the Association of Consulting Engineers will apply to the contract.

Tenders must be on the form provided and must be delivered to the Clerk to the Council, addressed to the Town Hall, Felixstowe, not later than Twelve Noon on Saturday, June 21st.

The Council do not bind themselves to accept the lowest or any Tender.

Deposits will only be returned upon receipt of a bona fide Tender accompanied by the specifications and drawings.

(Signed) MONTAGUE HUMPHREY, Town Clerk.
Town Hall, Felixstowe. 5851

Tenders are Invited by the Cattewater Commissioners for the REMOVAL of ROCK in the Harbour of Cattewater, Plymouth.

Particulars can be obtained from the undersigned, to whom Tenders, under seal, are to be delivered, not later than Saturday, 31st May, 1924.

The Commissioners do not bind themselves to accept the lowest or any Tender.

H. VICTOR PRIGG, Assoc. M. Inst. C.E., Engineer to the Commissioners.
South Devon Chambers,
Plymouth. 5800

The Great Indian Peninsula RAILWAY COMPANY, 48, Copthall-avenue, London, E.C. 2, invite TENDERS for—
1. STATIONERY, &c. ..... Fee 10s.
2. LAMP GLASSES, &c. ..... „ 7s. 6d.
3. PAINTS, &c. ..... „ 7s. 6d.
4. ELECTRIC OVERHEAD TRAVELLING CRANES. ..... „ 10s.

Tenders are due by 11 a.m. on 3rd June, 1924. Tender forms obtainable at above address. Fees not returnable. 5847

Aberdeen Waterworks. RESIDENT ENGINEER WANTED IMMEDIATELY; must be active and reliable and have good experience of concrete and reinforced concrete. Salary £320 per annum. Apply, with full chronological statement of experience, testimonials, age, state of health, &c.

GEORGE MITCHELL, Water Engineer.
41½, Union-street, Aberdeen. 5820

City of Sheffield. WATER DEPARTMENT.

APPOINTMENT OF ASSISTANT WATER ENGINEER.

APPLICATIONS are INVITED for the APPOINTMENT of ASSISTANT WATER ENGINEER.

Candidates must be properly qualified Engineers, and have had practical experience in the Distribution of Water, the Maintenance of Impounding Reservoirs and Works, Distributary Pipes, the Detection and Prevention of Waste, and the control of workmen. Preference will be given to Associate Members of the Institution of Civil Engineers.

Salary, £350 to £400 per annum.

Candidates will be required to devote the whole of their time to the service of the Corporation.

Applications, stating age, qualifications and experience, accompanied by copies of three recent testimonials, endorsed "Assistant Water Engineer," to be sent to me not later than Thursday, 29th May, 1924.

WILLIAM TERREY, General Manager.
Town Hall, Sheffield,
13th May, 1924. 5770

New Zealand.

APPLICATIONS are INVITED for an ASSISTANT CHIEF MECHANICAL ENGINEER to the New Zealand Government Railways. Commencing salary, £850 per annum, rising to £1000. Age limit, 40.

Applicants are required to have had practical experience of the Control of the Locomotive Running Branch of a Railway operated by Steam, and to have held a responsible position on a Railway equipped for Electric Traction.

Further particulars and forms of application obtainable from the HIGH COMMISSIONER FOR NEW ZEALAND, 415, Strand, London, W.C. 2, by whom completed applications will be received up to and including 21st June, 1924. 5786

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PUBLIC NOTICES

Western Australia.

APPLICATIONS are INVITED for the POSITION of ENGINEER-IN-CHIEF of the PUBLIC WORKS DEPARTMENT of the Western Australian Government. The position is a permanent one under the Public Service Act. The successful applicant will be responsible for the Control of all Engineering Matters, including Design and Construction. Public Works comprise Water Supply, Drainage, Irrigation, Harbours, Roads, Bridges and Construction of New Railways. Commencing salary, £1500 per annum, rising to £2000 by annual increments of £100. Transport allowance, £200 for married man, £100 for single man. Should the successful applicant voluntarily relinquish the position before the expiration of two years from the date of his appointment, he will be called upon to refund the amount of Transport Allowance.

Applicants should state age and whether married or single.

Applications, which should be endorsed "Engineer-in-Chief," must reach the AGENT-GENERAL FOR WESTERN AUSTRALIA, Savoy House, Strand, London, W.C. 2, on or before 7th June, 1924. 5760

SITUATIONS OPEN

WANTED, TECHNICALLY TRAINED MAN for Translation of Patent Specifications from French and German. State age, salary and experience.—Address, 5817, The Engineer Office. 5817 A

GENERAL MANAGER REQUIRED for a Large Structural and Gas Engineering Works in the Midlands (Birmingham district), employing about 700 hands. Applicants must have had a thorough theoretical and practical engineering training in the Design and Construction of Gasholders, Purifiers, Gas Plant and Structural Steelwork; must be fully qualified to work out calculations of stresses and strains, and to take general administrative management.—Apply by letter (which will be treated confidentially), stating age, experience and salary expected, to Z. B. H., care of Deacon's, 7, Leadenhall-street, London. 5761 A

ENGINEER REQUIRED (30/35), Possessing Real selling ability, for London firm of Contractors' Machinery Merchants. Only men of commercial experience need apply, stating age, salary required, and training. Applicants must be capable to conduct correspondence and take charge of growing department under the principal.—Address, 5779, The Engineer Office. 5779 A

FIRM of Industrial Furnace Manufacturers REQUIRE well-connected REPRESENTATIVE for London district, commission basis.—Address, 5850, The Engineer Office. 5850 A

GENERAL MANAGER REQUIRED by Electrical Supply Company in Spain; a gentleman, thoroughly experienced in the economical organisation and control of modern electric generating and supply installations. A knowledge of the Spanish language is desirable.—Applications, giving full particulars of experience, names of referees and salary expected, should be forwarded to 5797, The Engineer Office, by the 31st inst. 5797 A

INDIA.—ENGINEER-SALESMAN WANTED for English Firm in Bombay; must have thorough knowledge of Steam Power Plant and Gearing as used in spinning and Weaving Mills. General Technical Knowledge and Drawing-office experience essential. Single man, under 30, preferred. Permanent post with good prospects for the right man. Salary according to qualifications.—Address, stating briefly training and experience, 5731, The Engineer Office. 5731 A

SKILLED ENGINEER WANTED, to Organise the Processing and Flow of Motor Cycle Components during manufacture. Good salary offered. State age, experience, and references in confidence.—Address, P9122, The Engineer Office. P9122 A

WANTED, DRAUGHTSMEN for Water-tube Boiler Work; must be thoroughly capable men and experienced in this class of work. Experience in Marine Work and Pipe Layouts will be considered.—Apply, stating age experience and salary required, to BABCOCK and WILCOX, Ltd., Lincoln. 5832 A

WANTED, First-class DRAUGHTSMAN for the North of England, with experience in the Design of Machinery for Stone Crushing, Screening and Cement-making and the Lay-out of Complete Plants.—Address, 5726, The Engineer Office, stating details of experience, age and salary expected. 5726 A

WANTED in London, TWO DRAUGHTSMEN, accustomed to Lay-out of Plant, Engines, boilers, Pipe Arrangements, Tank Work, &c.—Address, stating full particulars, age, experience and salary required, together with copies of references, 5852, The Engineer Office. 5852 A

CONSTRUCTIONAL DRAUGHTSMAN, Well Experienced in designing Steel Work to L.C.C. requirements. State experience and salary required.—Address, P9125, The Engineer Office. P9125 A

DRAUGHTSMAN, Experienced in General Engineering, particularly with reference to Lay-out of Plants. Previous experience in Central Station Work desirable, but not essential. Non-pensionable conditions. Class A Grade V (approximately £277 p.a. at present). The appointment is subject to the provisions of the Local Government and Other Officers' Superannuation Act, 1922.

Applications, stating age, training and experience, accompanied by copies of recent testimonials, should be endorsed "Draughtsman," and sent to Major H. BELL, City Electrical Engineer, Sculcoates, Hull. 5839 A

DRAUGHTSMAN, Experienced in Steam and Electric Winders for Collieries.—Apply, stating age, experience, salary required, and when available, to FRASER and CHALMERS ENGINEERING WORKS, Erith. 5795 A

DRAUGHTSMAN (Jig and Tool) REQUIRED IMMEDIATELY, varied class of work. Only those with up-to-date tool-room experience need apply, stating age, experience, and salary required.—Address, 5795, The Engineer Office. 5795 A

DRAUGHTSMAN REQUIRED for Dredger Work; good general knowledge of Heavy Machinery and Structural Steel Work essential. Must have good experience and references. Salary £6 per week.—Address, 5801, The Engineer Office. 5801 A

DRAUGHTSMAN REQUIRED for Work in London, with large firm of Mechanical Engineers; must be thoroughly experienced in Belt Conveyor Work handling all materials.—Address, stating age, experience and salary required, 5763, The Engineer Office. 5763 A

DRAUGHTSMEN REQUIRED TEMPORARILY for Structural and General Railway Work.—Address, stating age, full particulars of experience and salary required, 5835, The Engineer Office. 5835 A

DRAUGHTSMAN WANTED. Must be Experienced in Colliery Screening Plants and Pit Head Gears. State age, experience and salary required.—Address, 5838, The Engineer Office. 5838 A

DRAUGHTSMAN WANTED, Preferably with Experience in Producer Gas and By-product Recovery Plants for large works in London district. State age, experience, and salary required.—Address, 5825, The Engineer Office. 5825 A

DRAUGHTSMAN, with Good Experience in the Design of Pumping Machinery, REQUIRED for East Midlands. State age, experience, and salary required.—Address, 5804, The Engineer Office. 5804 A

AUCTIONS

IMPORTANT SALE BY AUCTION IN ONE LOT OF

THE TRADE NAME, GOODWILL, AND WORKS EQUIPMENT

OF

MESSRS. COCHRANE AND CO. (WOODSIDE), LTD., DUDLEY,

ENGINEERS, CAST IRON PIPE AND GENERAL IRONFOUNDERS, PIG IRON SMELTERS, AND OWNERS OF

IRONSTONE MINES (FREEHOLD AND LEASEHOLD) IN OXFORDSHIRE.

ESTABLISHED IN 1840, AND KNOWN IN ALL THE MARKETS OF THE WORLD.

Mr. Duncan J. Shedden, F.A.I.,

is instructed by Messrs. COCHRANE and CO. (WOODSIDE), Ltd., DUDLEY, to OFFER FOR SALE by PUBLIC AUCTION, in one Lot, as set out below, if not previously disposed of by private treaty, subject to conditions of sale, at

THE GRAND HOTEL, BIRMINGHAM,

ON THURSDAY, JUNE 19, 1924, AT 2.30 p.m. PUNCTUALLY,

THE WHOLE CONCERN,

comprising

26a. 1r. 12p. FREEHOLD SURFACE LANDS AT WOODSIDE,

with the VALUABLE MINES and MINERALS under, 24a. 2r. 6p., comprising the usual South Staffs. Measures of Brooch, Thick Coal, Heathen and Gubbin Ironstone, all of which are unworked save the Thick Coal, which has, it is believed, been worked over once prior to 1835, together with the extensive and

SUBSTANTIALLY-BUILT WORKS SHOPPING AND ERECTIONS,

brick built, with slated roofs, STABLING for 50 horses, with Chaff and Fodder Rooms; WAGON GARAGES and LOCO. SHEDS. A Suite of ELABORATELY FITTED OFFICES, suitable and conveniently arranged for a large staff. A SIX-ROOMED DWELLING-HOUSE, No. 222, PEDMORE-ROAD.

The WORKS are conveniently situated for Transport, with long frontages to the Pensnett Canal and to the Dudley Branch of the Birmingham Canal, with the benefit of a special agreement for carrying material thereon, and connected by Sidings with the Main G.W. Railway Line at Round Oak and Woodside, and within the Works' boundaries are some 12,500 YARDS of PERMANENT WAY, and 2ft. 8½in. GAUGE RAILWAYS.

THE BLAST-FURNACE PLANT,

comprising TWO MODERN BLAST-FURNACES, 65ft. high by 16ft. dia. at the bosh, with steam-driven Hoist; Four Cowper Stoves, each 21ft. dia. by 51ft. to 57ft. high; Four Slack-fired Gyers' Calcining Kilns, capable of dealing with 1500 tons of ore weekly; a Hornbeam type Condensing Blast Engine, 53½in. cyl. by 10ft. stroke, with 8ft. 8in. Blowing Cylinder, housed in massively built Engine-house, 69ft. by 22ft. by 66ft. high, with C.I. Tank Roof, 4ft. deep; an auxiliary Blowing Plant, separately housed; the Steam-raising Plant, consisting of Five Lancashire Boilers, 8ft. 6in. dia. by 30ft. long, and Six Egg-ended Boilers up to 43ft. long, all in bricksettings and fired direct with Gas from the Blast-furnaces; the Steam Feed and Blow-off Pipes and system of Pumps; the Blast, Gas, and Water Cooling Mains; Two practically new Worthington Simpson Centrifugal Pumps, each 55,000 gallons per hour capacity, driven by Two 25 B.H.P. D.C. Shunt-wound Motors and connections; the Cake and Ore Bunkers and Gantries and C.I. Floors.

One Furnace is newly lined and ready to blow in, and No. 4 Stove is practically new; AN OUTPUT OF 650 to 700 TONS WEEKLY FROM EITHER FURNACE HAS BEEN AVERAGED FOR LONG PERIODS, AND THE FURNACES HAVE BEEN RUN FOR MONTHS ON A SELF-FLUXING BURDEN.

THE CAST IRON PIPE AND GENERAL FOUNDRY PLANTS,

capable of an output of 30,000 tons per annum, working on a single shift, comprises ELEVEN VERTICAL PIPE CASTING PITS FOR C.I. PIPES, 3in. to 48in. dia., in massive buildings, with gas-heated Core and Socket Drying Stoves; Four 2-Motor Cranes, to lift 2½ to 4 tons, and Nineteen 1-Motor Cranes to lift from 2½ tons to 20 tons.

THREE LARGE CASTINGS FOUNDRIES, SUITABLE FOR CASTINGS UP TO 10 TONS, with Four 10-ton steam-driven Cranes and Twelve Hand Cranes, with a 5 and 2-ton Hand Travelling Cranes; GREEN SAND FOUNDRIES for C.I. Pipes, 1½in. and upwards. There is a 5-ton Steam Loco. Travelling Crane, 4ft. 8½in. gauge, for loading purposes and removing boxes, &c.

A BATTERY OF SIX DUFF GAS PRODUCERS,

Five 10ft. 6in. and One 8ft. dia. by 10ft. high, with Hydraulic Lifts, Cages, and Platforms, and C.I. flue connections to Foundries, Pipe Pits, and Stoves.

TEN CUPOLAS, EACH OF AN AVERAGE CAPACITY OF 4½ TONS PER HOUR,

with C.I. blast connections to a 200 H.P. Positive Scavenger Gas Engine, coupled to a 54in. Blowing Cylinder erected in Power-house; a CORE BAR MAKING SHOP, with a 6-ton Hand Travelling Crane;

A BELT-DRIVING BORING MILL FOR PIPES UP TO 12IN. DIA.

Eleven HYDRAULIC PROVING PUMPS, for straight pipes, 3in. to 48in. dia.; Two Pumps for special pipes, 3in. to 42in.; and One Pump for straight and specials, 3in. to 6in., with Overhead Traveller; Set of BERRY'S PUMPS driven by 30 H.P. Blast-wound Motor, with COMPRESSOR driven by 20 H.P. Shunt-wound Motor; Ten Motor-driven CUTTING-OFF MACHINES, for pipes 3in. to 42in. dia.; Six Motor-driven LOAM MILLS and connections suitably housed, and Motor-driven Mortar Mill; DIPPING PLANT, with Motor-driven Cranes, for 9ft. pipes up to 10in. dia.; DIPPING PLANT and Motor Crane for 12ft. pipes from 3in. to 48in. dia., with delivery gantries to Loading Wharves.

THE ENGINEERING EQUIPMENT

consists of THREE FITTING SHOPS, WITH TWO 3-MOTOR 10-TON OVERHEAD TRAVELLING CRANES; the ranges of Line Shafting driven by 150 H.P. Positive Scavenger Gas Engine and connections from Mond Gas Plant, and the full equipment of massively constructed Lathes, Planing, Slotting, Shaping, Drilling, and Boring Machines; SMITHS' SHOPS, with Two Pilkington Steam Hammers, 3 and 5 cwt.; C.I. Hearths, with Motor-driven Keith-Blackman Fan; a 12-ton Goliath Crane, with compound-wound single 20 H.P. Motor, working between Foundries and Fitting Shops; PATTERN SHOP, with motor-driven Lathes, &c.; SAND MIXING SHED and Motors therein; the various Brick and Wood-built STORES and Fitments therein; SAW MILL, with Saw Bench to take 4ft. 3in. dia. saw, and 26 B.H.P. Shunt-wound Motor drive.

LARGE BRIDGE BUILDING YARD,

with 150 H.P. Positive Scavenger Gas Engine; Two Goliath Travelling Cranes to lift 12 tons, mounted on rails, with 20 H.P. Compound-wound Single Motors; a 12-ton Scotch Derrick Crane, with 27 H.P. Series-wound Single Motor; Two Foundry Delivery Jib Cranes, with 10 H.P. and 3 H.P. Series-wound Motors.

THE POWER AND LIGHTING PLANT,

CONSISTING OF TWO 10-TON MOND GAS PRODUCERS EQUAL TO 2000 H.P. and Feed Gantry, with 40 H.P. Vertical Engine; Two Cameron Pumps, 11in. by 7in. by 10in.; a Thwaites No. 3 Blower, Two Superheaters, Air Heating and Gas Cooling Towers, Washer with Dashers, Gas Holder of 2000 cubic feet capacity, Gas Washing and Momentum Fan, Two Settling Tanks and Two C.I. Sawdust Scrubbers and all connections to Two 250 H.P. Positive Scavenger Gas Engines, by the Premier Gas Engine Co., coupled direct to Two 150 K.W. Dynamos, with Switchboard, housed in massively constructed Power-house, with a Tangye's Hand Overhead Travelling Crane, with 8-ton Brake Crab and set Weston's Geared Differential Blocks, tested to 12 tons; the Distributing Mains supplying current to the Cranes, Pumps, and Motors about the Works, with 8½ Miles Aerial and Vulcanised Cable to Lighting and Power Points, carried on 1246ft. run of Poles in 11 tons C.I. Pipe Sockets, with all Fittings and Lamps. AN AUXILIARY LIGHTING AND POWER PLANT, separately housed, consisting of Two 40 H.P. Engines and Two 24 K.W. Dynamos, and all connections, with interchange Switch to the Main Power-house.

A CAREFULLY ESTIMATED DEPOSIT OF

ABOUT 500,000 TONS OF FURNACE SLAG,

with Motor-driven Cracker Plant on permanent way siding, with Tramways and Loading Stallages. This Slag is at present being hand worked, and consists of a large percentage of Cold Blast Slag.

113 ACRES OF FREEHOLD IRONSTONE MINES AT ADDERBURY,

near BANBURY, OXON, which comprises a Very Desirable

AGRICULTURAL HOLDING KNOWN AS "ST. MARY'S,"

consisting of RICH and WELL-WATERED PASTURE and Sound ARABLE LAND, in the occupation of Mr. John Bennett on a yearly Old Michaelmas tenancy at a rental of £224, and

64 ACRES OF UNGOTTEN LEASEHOLD IRONSTONE MINES

ADJOINING THE FREEHOLD, and connected with the G.W. Rly. at Adderbury Station by permanent Sidings, and a system of 24in. gauge Tramways to the various faces of work, in all about 150 tons of Rails and Chairs, Hauling Engine and Gear, and Fixed Weighbridge.

The purchaser will be required to take, at a Valuation to be made in the usual way, the Quarry and other Loose Tools, 61 Wood Side-tip Wagons, and Sundries at Adderbury; and One Peckett and Three Hunslet Tank Locos., 2ft. 8½in. gauge; 83 new specification 10-ton Railway Trucks, all recently overhauled; 20 Horses, with 16 Carts and Tackle; the varied and carefully assorted equipments of Boxes, Kibbets, Rings, &c., Loose Plant, Tools, &c., other than those enumerated in the Schedule of Fixed Plant; the unconsumed Stock of Pipes and Stores; a Sentinel 5-ton rubber-tyred Tipping Steam Wagon; a Mann's Patent 3-ton Steam Wagon; Laboratory and Office Furniture and Effects; Electrical and Furnace Sundries; about 15,000 Tons of Adderbury Ore (7000 tons of which is slacked with 700 tons slack and ready to fire); about 900 Tons Flue Cinder, the whole of which lie on and about the Woodside Works. A Schedule of which is in preparation and which will be ready prior to the Sale.

Plans of the Woodside and Adderbury Properties, with Condensed Schedules of the Erections and Fixed Plant which is included in the Sale of the Concern, and Conditions of Sale appertaining to the same, are being prepared, and may be had on application to Messrs. BEALE and CO., Solicitors, 12, Newhall-street, Birmingham (Tel., Central 3565); or to the 5722 J

AUCTIONEER, 2, PRIORY STREET, DUDLEY (Tel. 2288).

SITUATIONS OPEN (continued)

EXPERIENCED DRAUGHTSMAN REQUIRED, Aircraft experience essential. State age, salary required and qualifications.—Reply, Box 856, T. B. BROWNE'S, Advertising Offices, 163, Queen Victoria-street, E.C. 4. 5812 A

EXPERIENCED DRAUGHTSMAN, Well Up in Elevator, Conveyor and Bunker Work of all descriptions. State experience, age, and salary required. Midland district.—Address, 5790, The Engineer Office. 5790 A

GOOD DRAUGHTSMAN WANTED AT ONCE, accustomed to Light and Heavy Constructional Steel Work. State experience and salary; send copies of references.—PRING and ST. HILL, Bedminster, Bristol. 5853 A

JUNIOR DRAUGHTSMAN, Used to Pump and Oil Engine Work, REQUIRED for Engineering Works on South Coast. State age, experience and salary required.—Address, 5806, The Engineer Office. 5806 A

LIVE DRAUGHTSMAN WANTED, with Experience in the Design of Conveying, Elevating, and Storage Plant, capable of acting on own initiative. State age, experience, and salary required, also when at liberty.—SANDYCROFT LTD., Sandycroft, near Chester. 5803 A

JUNIOR ENGINEERING DRAUGHTSMAN, Experienced in Reinforced Concrete or Steel Work, REQUIRED by leading firm of Reinforced Concrete Specialists. State age, experience, and salary required. —Address, 5798, The Engineer Office 5798 A

SITUATIONS OPEN (continued)

THE CHATWOOD SAFE CO., Ltd., Bolton, Would be glad to receive APPLICATIONS for the POSITION of DRAUGHTSMAN.

Applicant must have had sound experience in design and manufacture of Steel Office Furniture.

Full particulars of experience, age, and salary required should be given, and addressed to the "TECHNICAL DIRECTOR." 5794 A

THOROUGHLY Experienced DRAUGHTSMAN REQUIRED, preferably with Condenser or Power Station experience. State age, experience, salary required, when at liberty.—Address, 5841, The Engineer Office. 5841 A

WANTED, FOREMAN, to Take Charge of Constructional Department in Large Bridge and Constructional Engineering Works in the West Riding of Yorkshire. Must have had considerable experience in this class of work. Man who has acted in a similar capacity preferred.—Address, giving particulars of experience and references, 5819, The Engineer Office. 5819 A

FOREMAN WANTED, to Take Charge of Shop in Calcutta manufacturing Riveted Steel Pipes. Applicants must be men experienced in circular work. —Apply, giving particulars of experience and salary required, to CLEVELAND BRIDGE CO., Darlington. 5824 A

WANTED, Derby District, ELECTRIC WELDERS, Carbon Arc Process; experienced in High-pressure Steam Pipework.—Address, 5849, The Engineer Office. 5849 A

REQUIRED, Thoroughly Competent TUBE BENDERS, capable of bending up to 12in. tubes, with or without flanges on. Position assured for really capable man.—Address, 5848, The Engineer Office. 5848 A

SITUATIONS WANTED

ADVERTISER, with Shops, D.O., Estimating and sales exp., been 5 years manager of general engineers, DESIRES PERMANENCY as PLANT ENGINEER or in some capacity assisting in management where above exp., coupled with energy, will prove useful.—Address, P9132, The Engineer Office. P9132 B

BUYER of ENGINEERING SUPPLIES, Who has a technical knowledge of materials, together with a wide knowledge of markets, DESIRES APPOINTMENT; is a good organiser and an experienced departmental administrator.—Address, P9128, The Engineer Office. P9128 B

CIVIL ENGINEER and BUILDING SURVEYOR REQUIRES POST. Age 28, good draughtsman, specifications and quantities; able to carry out works; London experience.—Apply, 53, Holly-lane, West Smethwick. P9136 B

CIVIL ENGINEER, Sound Practical Experience in carrying out all classes of building construction, surveying, drawing-office, &c., also thoroughly experienced in factory management, control of labour and general commercial practice, thorough experience of cement manufacturing, SEEKS RE-ENGAGEMENT.—Address, P9120, The Engineer Office. P9120 B

COST ASSISTANT (23), Well Educated, Practical and technical engineering training in all branches, including foundry; good costing experience, estimating, production reports, analyses, summaries.—Address, P9135, The Engineer Office. P9135 B

DIESEL ENGINEER (30), Well Educated, 1st Class B.O.T. Steam and Diesel Certificate, Exec. Lieut. R.N.R., free July, experience supervising upkeep and repair of steam and Diesel machinery, turbines, water-tube and other boilers, workshop practice, &c., SEEKS POSITION of responsibility.—Address, P9087, The Engineer Office. P9087 B

ECONOMIC GEOLOGIST and PETROLEUM TECHNOLOGIST, qualified and wide experience (extending over 20 years), OPEN to UNDERTAKE REPORTS on Petroliferous Areas and Fields, or Geol. Surveys, Examinations, &c. (either on behalf firms of engineers or independently).—Address, P9114, The Engineer Office. P9114 B

ENGINEER, Mechanical and Electrical, 16 Years as engineer and works manager, DESIRES SIMILAR POST. Accustomed to all classes of machinery and establishment lay-out and upkeep; charge of large steam and gas power plants, electric, hydraulic and pneumatic installations.—Address, P9107, The Engineer Office. P9107 B

ENGINEER, Mechanical, Electrical and Civil, with capital experience in all branches, including production, installation and maintenance of steam (marine and stationary), I.C.E., electric, hydraulic, pneumatic, foundry and colliery plants, 18 years control, references, SEEKS responsible POST, home or abroad.—Address, P9123, The Engineer Office. P9123 B

FRANCE.—Eleven Years Automobile, Aircraft, general, foundry plant, metal trades, covering shops, costing, progress, design, maintenance, research, sales, technical and trade journalism, including editorial control, qualifications in engineering, economics, commerce, excellent French, SEEKS POST in FRANCE.—Address, P9119, The Engineer Office. P9119 B

IRONMOULDER, Age 35, Having 21 Years' Experience, SEEKS POSITION as Foundry Foreman, knowledge of general and repetition work, with green or dry sand.—Address, P9127, The Engineer Office. P9127 B

MARINE ENGINEER (38), 1st Class B.O.T. Certificate, 8 years' experience as manager, ship repairing works, also consulting work, SEEKS POSITION with good firm marine consulting engineers or management ship repairing works, at home or abroad. Wide experience all classes ship repairs, supervision of building of new vessels, surveys, reports, and expert knowledge prices.—Address, P9096, The Engineer Office. P9096 B

MECH. ENGINEER (36), 1st Class B.O.T., Lately returned from the East, SEEKS POSITION at home or abroad. Experience: erection and maintenance of large textile mills, workshop and foundry management, including launch, cargo boat and jetty repairs.—Address, P9100, The Engineer Office. P9100 B

METALLURGICAL ENGINEER, with 15 Years' experience blast-furnaces, open hearths, and rolling mills, SEEKS EMPLOYMENT in England or abroad. Speaks French, Russian. Best references.—Address, 5694, The Engineer Office. 5694 B

TANK EXPERT WISHES to REPRESENT Good FIRM, also gas and coke oven plant, constructional and general work, N. of E.—Address, P9105, The Engineer Office. P9105 B

TO CONSULTING ENGINEERS AND OTHERS.—CHARTERED CIVIL ENGINEER, at present occupying responsible position, shortly available to act in advisory capacity, will TAKE UP INSPECTING ENGINEERING WORK or REPRESENT reputable FIRM in Manchester district, specialising in electrical, mechanical and internal combustion engines of all descriptions.—Address in first instance, P9130, The Engineer Office. P9130 B

WHIT. SCH., B.Sc., DESIRES OPENING, Home or abroad; 6½ years shops and D.O., naval arch., construction engineering or aeronautics.—Address, P9116, The Engineer Office. P9116 B

YOUNG ENGINEER, Smart, Energetic, REQUIRES RE-APPOINTMENT, home or abroad. Motor and steam engineering experience, also business experience in hire purchase; excellent references.—Address, P9118, The Engineer Office. P9118 B

YOUNG MAN (22) SEEKS SIT. with Prospects; 6 years pattern shops, foundry and D.O. experience, energetic; tool designing preferred.—Address P9134, The Engineer Office. P9134 B

YOUTH (20) DESIRES SITUATION as IMPROVER to Mechanical Fitter, preferably marine work. Excellent references, terms moderate. Five years assisting engineer maintenance machinery, attendant to steam (beam) engine, tubular boiler, hydraulic pumps, and heating boilers. Attending evening school for technical education.—Address, P9117, The Engineer Office. P9117 B

DRAUGHTSMAN and ENGINEER, London, 12 years shops, 14 years office, all-round experience, including patents, moderate salary, or private work undertaken.—Address, P9129, The Engineer Office. P9129 B

DRAUGHTSMAN (21) SEEKS ENGAGEMENT; knowledge of Diesel engine design and power station lay-out thoroughly acquired; 3 years works, 5 years' D.O. experience.—G. SMITH, 157, Hartington-road, South Lambeth, S.W. 8. P9133 B

COMMERCIAL RECONSTRUCTIONS, LTD.,

1, POST OFFICE CHAMBERS, DERBY.

Engineering undertakings reorganised by specialists.

Non-paying concerns reconstructed.

Active management where desirable.

Additional Capital in approved cases.

The fullest investigations are invited and required.

For continuation of Situations Wanted see page 3.

A Seven-Day Journal

The Falls of Clyde Scheme.

AFTER hearing evidence for five days on the Lanarkshire hydro-electric power scheme, for harnessing the waters of the Clyde Falls, the House of Commons Committee, presided over by Lord Clarendon, recently decided that the Bill should proceed. Mr. R. A. Ross, of Ross and Holgate, consulting engineers, Montreal, stated that he visited the Falls of Clyde in 1902, and reported on the adaptability of the area for a hydro-electric scheme. After investigations in 1912 his firm submitted a second report. The engineering problems did not present any difficulty, and he estimated the production cost per unit, if his scheme had been carried out, at .11d., which was less than one-fifth of the cost specified by Mr. R. Robinson, of the Clyde Valley Company. Addressing the committee on behalf of the promoters, Mr. Tyldesley Jones remarked that none of the opponents of the scheme had said anything against the engineering aspect of the undertaking. After a minute's consideration in private, the committee expressed its approval of the Bill by announcing that it should proceed.

Wireless Aerials.

ALTHOUGH much has been published on the erection of wireless aerials, many very imperfect aerials exist. The latest departure from recognised practice, however, is the erection of aerials across public streets. In Edinburgh aerials, it seems, stretch between the houses on opposite sides of the road, and steps are about to be taken to make the owners remove them. It has been reported to the sub-committee of the Town Council's Streets and Buildings Committee that the number of these aerials is increasing daily, and that many of them are very unskilfully attached to trees, chimney pots, or brackets. The sub-committee has agreed to recommend that steps be taken to prohibit the erection of such aerials, and that notices should be sent out calling upon the offending parties to have the aerials removed forthwith.

Port of London Improvements.

WE understand that the Port of London Authority has decided to proceed at once with the construction of the new floating passenger landing stage, which, under its port improvement scheme, is to be erected at Tilbury. The landing stage, which will be 2000ft. in length and 80ft. wide, will be connected to a new Tilbury station, which will be constructed by the London, Midland and Scottish Railway Company. Altogether nine covered gangways and two road bridges will be used to connect the floating landing stage to the shore, and facilities will be provided to enable liners to discharge at two levels simultaneously, communicating with upper and lower decks on the landing stage. The work involved will, we learn, include, besides the gangway, the building of covered circulating areas, large Customs shed, and a new river wall 900ft. long. Alterations to the station provide for the construction of six platforms. Some dredging will be necessary to allow the largest liners calling at the port to berth. It is estimated that the total cost of the work will involve an expenditure of about £950,000. It is expected that operations at Tilbury will begin in about two months' time. Full details of the scheme referred to were given in an article which appeared in THE ENGINEER of August 3rd, 1923.

Agricultural Machinery Tests.

FOLLOWING the report issued at the beginning of last month by the Machinery Advisory Committee, the Minister of Agriculture and Fisheries has appointed a committee to formulate a detailed scheme for tests of agricultural machinery. The committee will consist of Professor Dalby (chairman), Mr. T. Close, of the Ministry of Agriculture; Mr. F. S. Courtney, consulting engineer to the Royal Agricultural Society; Messrs. H. Deck, H. German and W. Harrison; Mr. B. J. Owen, of the Oxford Agricultural Engineering Institute, and Dr. Stanton. The committee is to consider the general and special regulations which should govern the admission of machines and implements for testing, the form of entry, certificate and report and the scale of fees to be charged, with a view to making the scheme as far as possible self-supporting.

The Howden-Ljungstrom Air Preheater.

IN our issue of February 22nd of this year we published an account of some tests made on a cylindrical marine boiler which was steamed with and without pre-heated air, and a description of the Howden-Ljungstrom air preheater was given. We learn with interest that a company has now been formed to develop and manufacture this boiler speciality. The new concern will represent the combined interests of Messrs. Howdens and the Swedish Ljungstrom Company, and complete manufacturing rights for world supply have been obtained by it. Preheaters will be manufactured at the large and well-equipped works of the Howden Boiler and Armament Company, Limited, at Helen-street, Govan, Glasgow, and it is understood that a considerable number of orders, both for land and marine installations, have already been obtained. The preheater, it will be remembered, is a novel device for recovering the heat wasted in furnace gases. It consists essentially of a number of rotating metal plates of thin corrugated form, which transfer the heat from the waste gases to the air which is to be delivered to the furnace. The gases and the air traverse the surfaces of the rotor plates in opposite directions, so that the exchange of heat is performed by a counter current process.

The World's Power Conference.

THE provisional arrangements for the World's Power Conference, which is to be held during the first nine days—with Saturday and Sunday excluded—in July, show that in all 309 papers are to be submitted! On some days two rooms will be available for meetings and on some three, but as far as we can see the total number of hours to be devoted to these 309 papers is 117½, or at the rate of one paper in .38 of an hour. It does not look as if the discussions are likely to prove a valuable feature of the Conference. The papers will be submitted by representatives of twenty-seven different countries, and will be classified in five main divisions, namely, Power Resources, Power Production, Power Distribution, Power Utilisation, and General. Each division will be subdivided into sections and sub-sections. We are told in the programme that the papers will be printed and distributed to the official delegates and members before the Conference opens. They will not, however, be read, but will be "synthesised in sections so that the sessions of the Conference may be devoted to the discussion of the subjects under review."

Large Liners in the Thames.

LAST month we had the pleasure of coming up the Thames as far as the King George V. Dock on the 21,000-ton liner Minnetonka, which has recently been added to the Atlantic Transport Company's fleet, and the ease with which this 625ft. ship was manœuvred into the dock was the subject of favourable comment. Up to that time the Minnetonka was the largest ship to berth in the Port of London, but her record is now broken by the Red Star liner Belgenland, which was brought up the Thames on Saturday and docked safely at 2 p.m. The Belgenland has been diverted from Antwerp, its ordinary port of call, on account of the silting up of the Scheldt. She has a total length of 670ft. with a gross tonnage of 24,547 tons. Like the Minnetonka and Minnewaska, she was constructed by Harland and Wolff at Belfast. Being a triple-screw boat, her extra size is compensated for somewhat by the ease with which she is handled. The operation of docking her on Saturday last was carried out very expeditiously. Her sister liner, the Lapland, will also call at London during her next few voyages, and it is not expected that these liners will resume their Antwerp calls until at least July, by which time it is hoped that the dredging of the Scheldt channel will be completed, giving again a safe depth of water for these large ships.

The Government's Airship Policy.

THE announcement of the policy to be pursued by the Government with respect to airships, while it no doubt relieves a certain amount of anxiety felt by those actively interested in this department of aeronautics, can hardly, we suppose, be regarded as meeting all their wishes. The Government has decided to reject the Burney airship scheme, which the previous Government approved before going out of office, on the ground that it would create a monopoly. Two airships are instead to be built, one at the Cardington (Bedford) works by the Air Ministry, the birthplace of the ill-fated Anglo-American airship R 38, and the other by the private company connected with the promotion of the Burney scheme, a company in which Vickers and the Shell-Mex Oil Company are closely interested. Both airships will be of five million cubic feet capacity. The capacity indicated, it may be noted, is nearly twice that of the largest airship—R 38—previously built in this country. After the Burney airship has completed successful trials she will be offered at a reduced price to her constructors for operation in connection with a British commercial airship service. It may be recalled that the late Government intended to include a sum of £400,000 in the current year's Air Estimates to meet the first instalment of the subsidy to be paid under the Burney scheme. In this connection it is worthy of note that, while no definite figure was published as to the cost of building the R 38, it was stated on good authority—in fact, on that of her designer, the late Mr. C. I. R. Campbell, who perished in the disaster which overtook her—that if a second vessel of her type were required she could be built for about a quarter of a million pounds. Allowing for the re-purchase of the second airship by the Airship Guarantee Company, the company formed to promote the Burney scheme, the Government estimates that its revised plans will not involve a net expenditure in excess of £1,200,000 spread over the next three years.

A New Shipyard on the Tees.

ON Monday work was begun at the new yard of William Gray and Co., Limited, on the Tees. This yard was planned before the war, but work upon it was suspended until 1920, when it was decided to resume operations and complete the building of a dry dock, fitting out basin and four shipbuilding berths. The dry dock is 500ft. long. A useful feature of the yard is the 1200ft. fitting-out basin, while the four berths are designed to accommodate vessels up to 700ft. in length. The original intention was to use this yard for the building and repairing of larger vessels than could be dealt with at the company's two other yards at the Hartlepools. At the present time there appears to be small prospect of securing orders for large ships which would fully employ the equipment of the new yard, but there is no doubt that repair work will be attracted to a yard so easily accessible and having such new and efficient equipment. The first vessel to enter the dry dock on Monday was the Ellerman liner Serbino, and we learn that she will be followed by the Melford Hall belonging to the same owners.

A Standard for Leather Belting.

AMONG large users of leather belting, such as the Admiralty, the War Office, railway companies, and other undertakings, the opinion has often been expressed that the existence of some standard for leather belting would greatly simplify the basis on which tenders for belting might be prepared. We now learn that in response to such expressions of opinion, the Federation of Leather Belting Manufacturers has just drawn up a standard specification, a copy of which may be obtained on application to the secretary of the Federation, Mr. L. D. Kidson, of 1, Booth-street, Manchester. At the time of writing we have not ourselves had an opportunity of examining the proposed standard, but the views of the Federation may perhaps be quoted. It is emphasised that the standard specification should be regarded as the minimum standard of quality by all buyers and users of belting who require belts of good and reliable quality. If the standard be rigidly adhered to in this sense, the Federation is of opinion that its existence will do much to eliminate inferior goods and promote a higher standard of quality.

Thames Bridges.

ALTHOUGH Waterloo Bridge has during the past week developed a westward inclination at the defective arch, so much so that it has been found necessary to relieve the weight on it by the removal of a portion of the superstructure, indications have been noticed that the settlement of the subsiding pier is abating. It has, in fact, been officially stated that if matters continued to proceed satisfactorily, the bridge might be reopened to pedestrians in the course of a few weeks. The closing of the bridge has undoubtedly served to convince Londoners of the inadequacy and unsatisfactory nature of their cross-river means of communication. At the present moment the City Corporation and the London County Council are the bodies responsible for the provision and maintenance of the Thames bridges within the London area, but there is little or no co-operation between them. The public will, therefore, welcome a satisfactory outcome to the present efforts of the Council to promote such co-operation. It is proposed that a joint commission of the Corporation and the Council should be appointed to inquire thoroughly into the adequacy and condition of the existing bridges and the necessity for additional means of transit across the Thames within the Administrative County of London, and to formulate a general policy on the subject.

State Ownership of the Engineering Industry.

WE are interested to observe that in the current issue of the Amalgamated Engineering Union *Journal* Mr. F. H. Rose, an official of the Union and a member of Parliament in the labour interest for Edinburgh, discusses the nationalisation of the engineering industry, and comes to the conclusion that it is an impossibility. "It is strange," he writes, "that the average State Socialist does not think of acquiring an industry until it has developed, under private enterprise, into an asset of enormous present material value." The State ownership of the engineering industry, he holds, cannot be secured by methods either of compensation or expropriation. Can any practical engineer, he asks, imagine the industry, with its manifold variation and ever-changing methods, being run by a department in Whitehall? Has bureaucracy ever demonstrated its possession of so much virtue or merit as to justify the nation entrusting it with such a responsible task? "Let it be remembered," he concludes, "that every scientific and inventive item in machinery development has come from individual private effort."

The British Empire Exhibition.

ENGINEERING EXHIBITS, No. V.*

ELECTRICAL ENGINEERING EXHIBITS.

ELECTROMOTORS, LIMITED.

ELECTROMOTORS, Limited, who have been building direct-current motors for the past twenty-five years, have recently produced a new design of which several examples are shown for the first time at Wembley. The company's long experience in the design of electric motors has been brought to bear on the development of two and three-phase machines, which are also to be seen at the Exhibition. In the centre of the company's stand there is a revolving turntable which carries a "Lo Thermo" motor suitable for use in places where there are acid fumes or where the air is laden with dust. This type of machine, which was described in our columns on January 5th, 1917, presents notable advantages over the ordinary type of totally enclosed machine. Large and small motor generators are exhibited, whilst pipe ventilated, cowl ventilated, waterproof, vertical and other types of motors are to be seen. Electromotors, Limited, were the main contractors for the electrical equipment of the Never-Stop Railway and for the model dairy in the milk pavilion. The company's motors are also used for working the Babcock and Wilcox cranes in the Electrical Section of the Palace of Engineering, the ventilating fan in the coal mine, and the machines in the Cotton Section.

MATHER AND PLATT, LIMITED.

NEAR the Stadium entrance to the Exhibition Mather and Platt, Limited, have installed a 500-kilowatt rotary converter for the purpose of coping with the heavy traffic upon the suburban tramway service to Wembley. The machine, which is fitted with the makers' patented starting and synchronising equipment, has been supplied to the North Metropolitan Electric Supply Company, but it constitutes one of the electrical exhibits at Wembley, for visitors are at liberty to view it. Another of these machines is to be seen on the stand of Bertram Thomas in the Palace of Engineering. The synchronising system used in the Mather and Platt rotary converters is designed on special lines, and it is claimed that an unskilled operator can start up a converter of any size from rest, synchronise it with ease and safety, and have the machine ready to be put into service in about thirty or forty seconds. If the polarity of the machine is reversed it can be made to build up its voltage in the right direction during the synchronising operations and without shutting down, the time taken to correct the polarity being very short indeed.

The stator of the pony motor is provided with a single winding, which is devoid of complications and has the same number of poles as the converter, the rotor being a plain cylinder of iron mounted on an extension of the main armature shaft, so that no additional bearings are required. The rotor gives a very high starting torque, which quickly brings the converter up to speed. By means of a patented arrangement, described in British Patent Specifications Nos. 137,144 and 140,554, the slip of the starting motor is reduced to a very low value. At the same time the synchronising torque exerted by the converter is considerably increased and the machine quickly pulls itself into step without hunting or surging. When the normal voltage has been attained the pony motor is cut out of circuit.

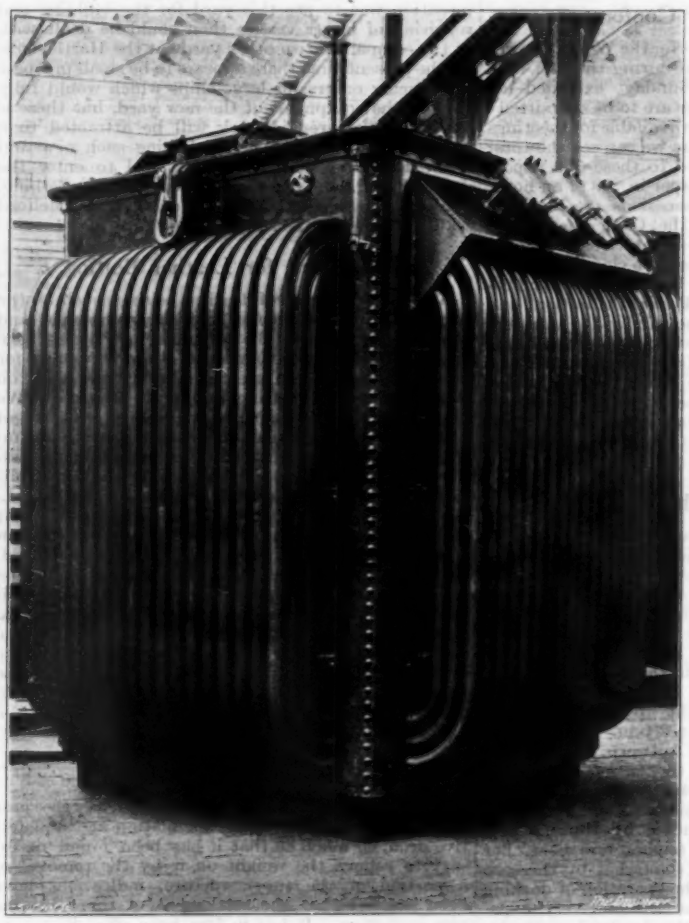


FIG. 103—TANK FOR 1875 K.V.A. TRANSFORMER—B.E.T. CO.

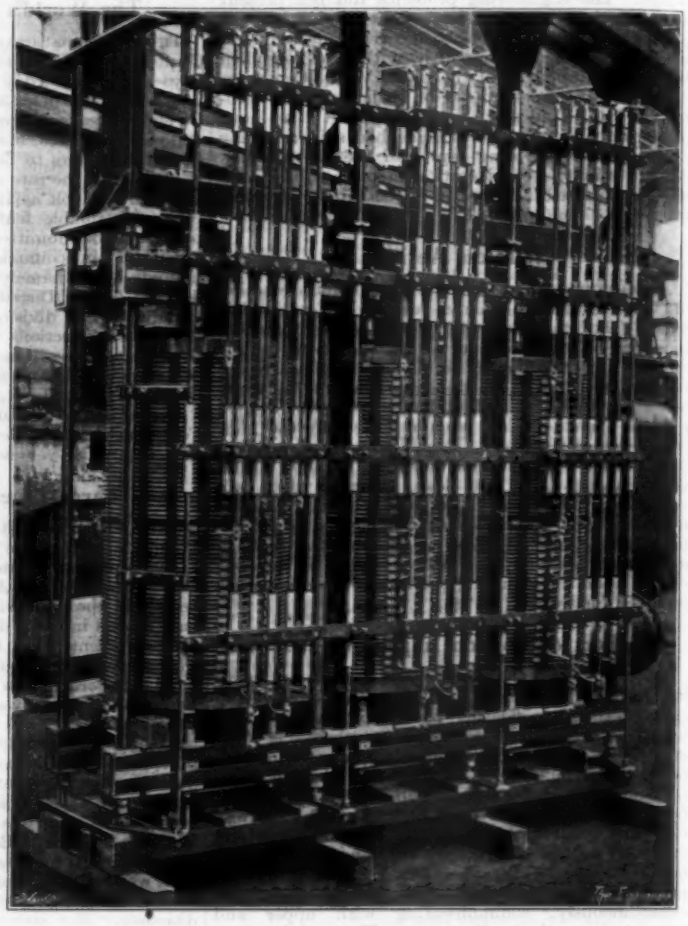


FIG. 104—CORE TYPE TRANSFORMER—B.E.T. CO.

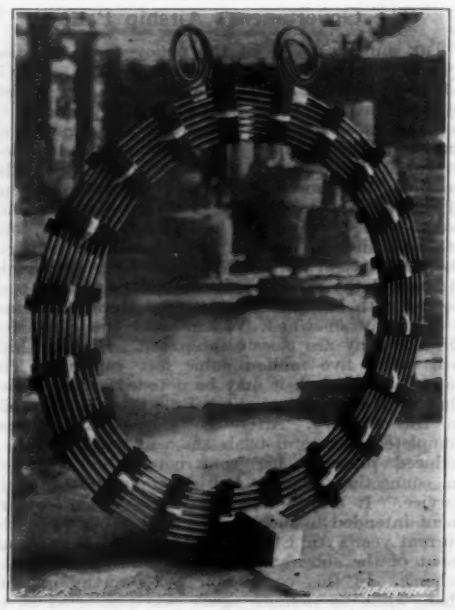


FIG. 105—HIGH TENSION COIL—B.E.T. CO.

In the cotton mill in the Palace of Industry Mather and Platt have supplied more than two-thirds of the total amount of electrical machinery, and many motors, &c., made by the firm are also to be seen on the engineering stands. The electrical exhibits on the company's own stand consist of an 80-kilowatt open pedestal direct-current generator giving 230 volts at a speed of 600 revolutions per minute, and also standard direct-current and alternating-current motors intended for all classes of industrial service.

BRITISH ELECTRIC TRANSFORMER COMPANY.

Some interesting transformers are being shown by the British Electric Transformer Company, of Hayes, Middlesex. The single-phase transformer shown in Figs. 106 to 109 page 559 and Fig. 103 has a capacity of 1875 kilovolt-ampères, the ratio being 20,000/3820 volts or 20,000/6500 volts with delta star connections. The periodicity for which this transformer has been designed is 25 cycles per second. The full load efficiency is 98.85 per cent., the impedance voltage being 4.02 per cent. Tappings on the secondary side—see Fig. 107—give voltages of plus and minus 2½ per cent. and 5 per cent. Including the oil, the weight of the complete transformer as shown in Fig. 103 is 3900 lb. The windings are concentric, the low-tension coils being wound directly on Bakelite cylinders, whilst the high-tension windings are single-layer coils which are also on Bakelite cylinders. The insulation between the turns consists of impregnated "Berrite" fabric, which is reinforced at the windings adjacent to the line terminals. The insulation between the primary and secondary windings and between the windings and the magnetic core consists of Bakelite cylinders.

Steel end plates are fitted at the top and bottom of the transformer and are tied together by stout steel bolts, two of which are provided with lifting eyes. All the windings are carried on the end plates by Bakelite distance pieces which are supported on sector-shaped steel dogs fastened by set screws

* No. IV. appeared May 16th.

1875 KILOVOLT-AMPÈRE SINGLE-PHASE TRANSFORMER

THE BRITISH ELECTRIC TRANSFORMER COMPANY, LIMITED, HAYES, MIDDLESEX, ENGINEERS

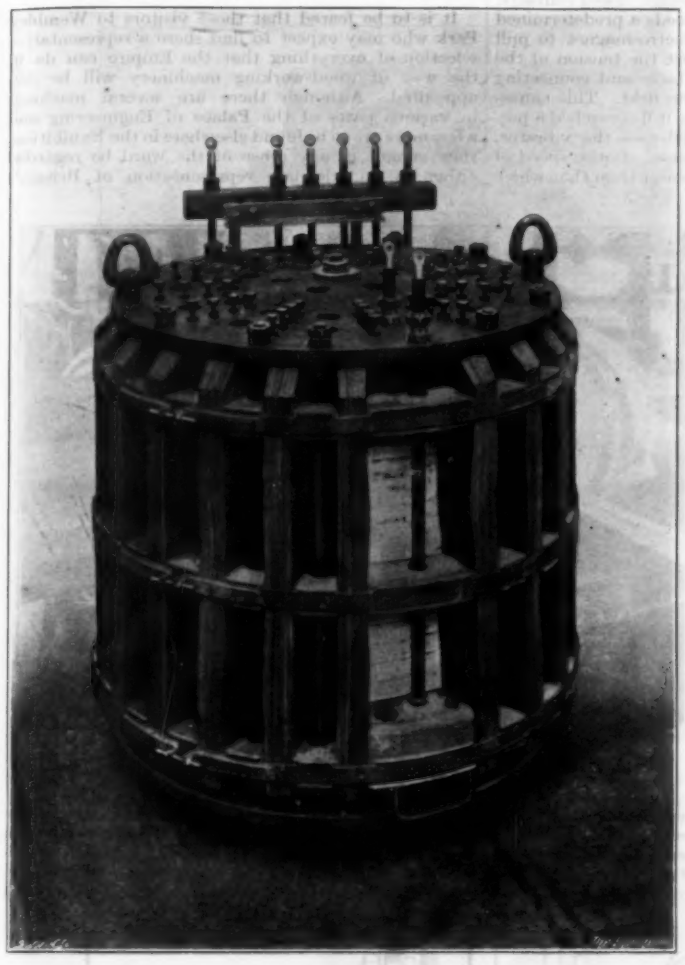


FIG. 106—PRIMARY SIDE

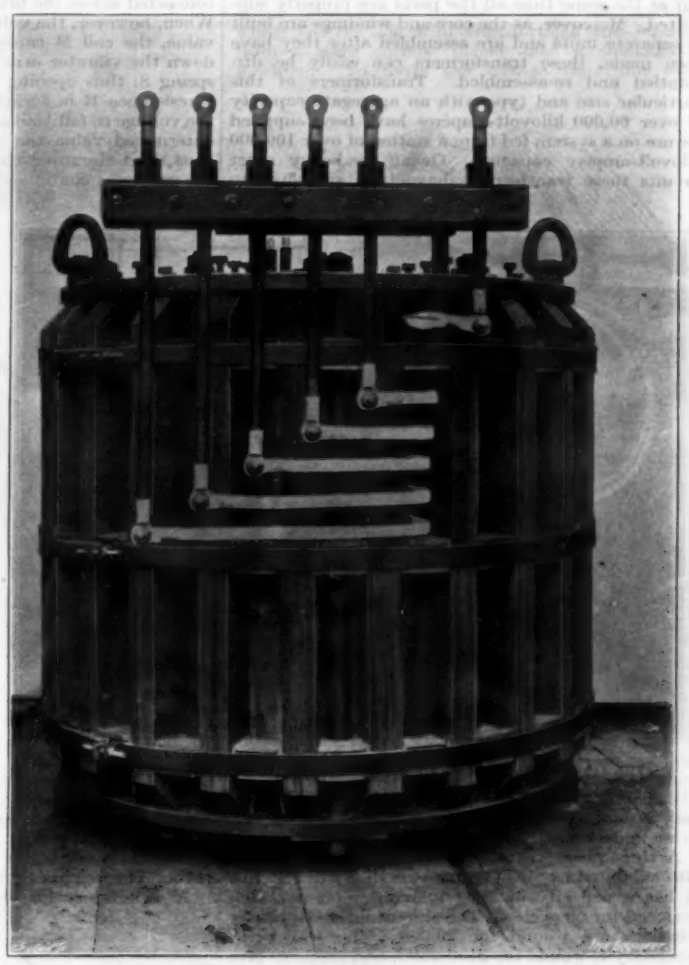


FIG. 107—SECONDARY SIDE

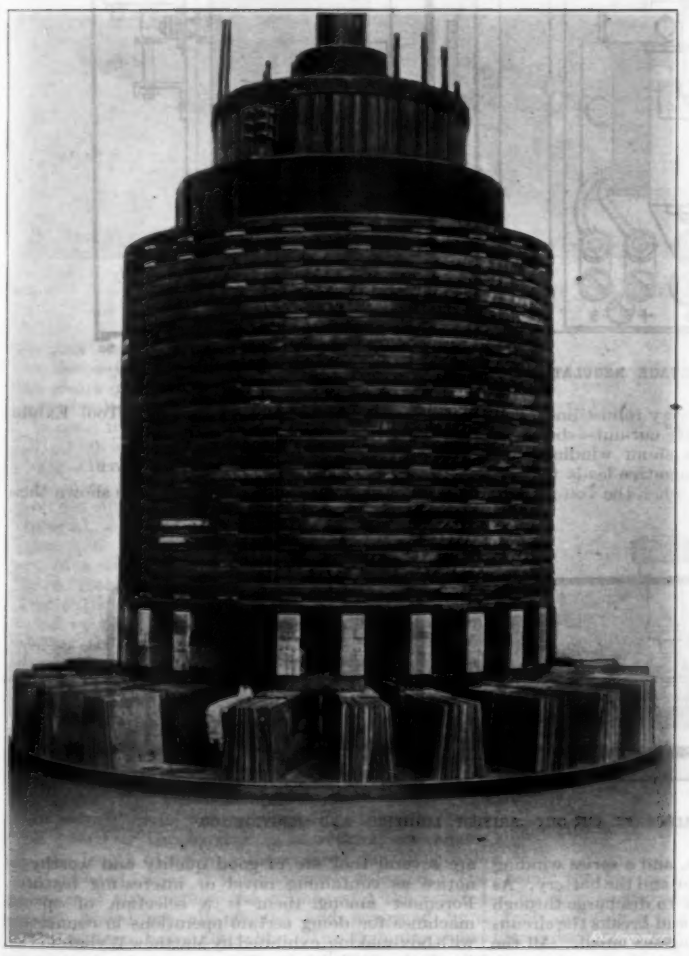


FIG. 108—20,000-VOLT WINDING

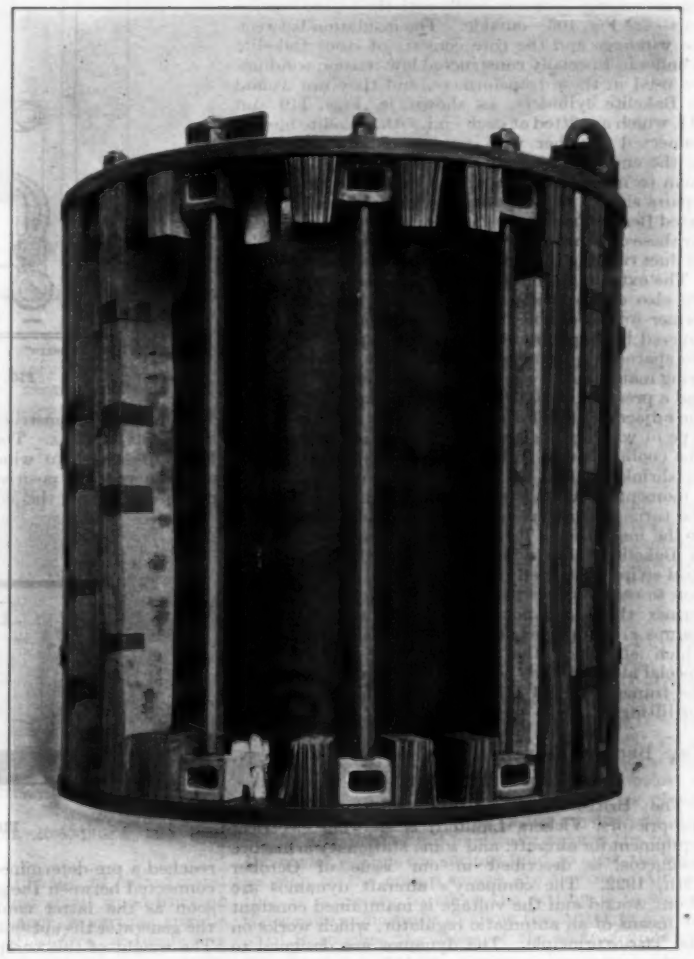


FIG. 109—TRANSFORMER PARTLY ASSEMBLED

which pass through the end plates, and to ensure a good mechanical support at all points the set screws are tightened whilst the transformer is hot. Vertical oil ducts in the core and windings provide circulating passages for the oil. As there are no bolts in the magnetic circuit local heating in the steel is avoided, but at the same time all the parts are properly supported. Moreover, as the core and windings are built as separate units and are assembled after they have been made, these transformers can easily be dismantled and re-assembled. Transformers of this particular size and type with an aggregate capacity of over 60,000 kilovolt-ampères have been supplied for use on a system fed from a station of over 100,000 kilovolt-ampère capacity. Owing to heavy short circuits these transformers have been subjected to very arduous duty, but no trouble of any kind has, so we understand, been experienced.

A three-phase, core type transformer, which is also exhibited by this Company, is shown in Fig. 104. It has a capacity of 2000 kilovolt-ampères and is designed for 50 cycles. The star connected primary windings are wound for 20,000 volts, whilst the secondary is wound for 2100 volts, and tappings give a 5 per cent. variation. The temperature rise at full load is 40 deg. Cent., the efficiency at full load 98.81 per cent., the impedance 4.7 per cent., and the total weight, including the oil, 34,000 lb. The windings are arranged concentrically with the higher tension coils—see Fig. 105—outside. The insulation between the windings and the core consists of stout Bakelite cylinders. Specially constructed low-tension windings are used in these transformers, and they are wound on Bakelite cylinders, as shown in Figs. 110 and 111, which are fitted at each end with Bakelite blocks, connected together with mild steel stiffening rods. As the ends are securely wedged it is impossible for them to move. Each coil may easily be removed if repairs should be necessary. Presspahn and impregnated Berrite fabric are the insulating materials used for these coils, which are efficiently cooled by a circular oil duct running the entire length of the winding.

The extra high-tension windings shown in Fig. 105 are also constructed on special lines and consist of former-wound double disc coils, the conductors being covered by impregnated paper and tape. The turns are spaced a quarter of an inch apart, the clearance being maintained by spacing strips shown in Fig. 105, and a pressure of 20,000 volts can be applied between the adjacent turns for a period of five minutes. This type of winding is claimed to offer great advantages. The cooling is said to be perfect. Moreover, there is no shrinkage, and as the insulating medium is oil, a momentary voltage surge and a puncture between the turns will not result in a permanent breakdown of the insulation. The low-tension leads are carried in Bakelite tubes which are clamped between flat steel strips supported by the rods, and double insulation to earth is thus provided. In this type of transformer there are no soldered joints. Mechanical clamps are employed for making all the connections, which simplifies the assembly of the windings. Special attention has been paid to the construction of the framework and suitable arrangements are made for lifting.

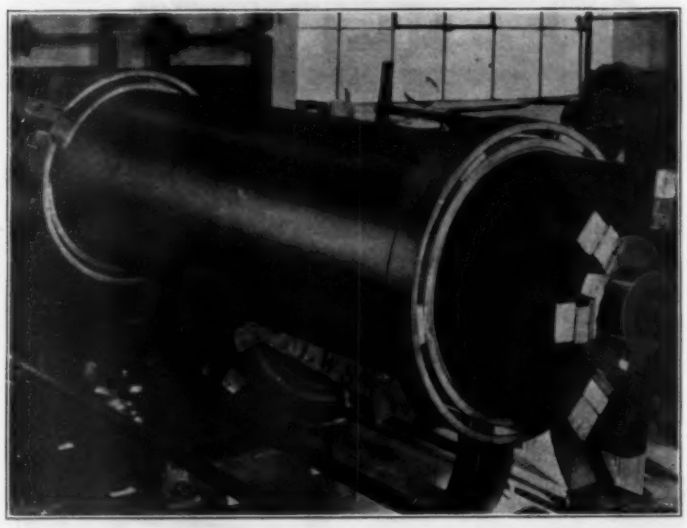


FIG. 110—BAKELITE CYLINDER—BRITISH ELECTRIC TRANSFORMER CO.

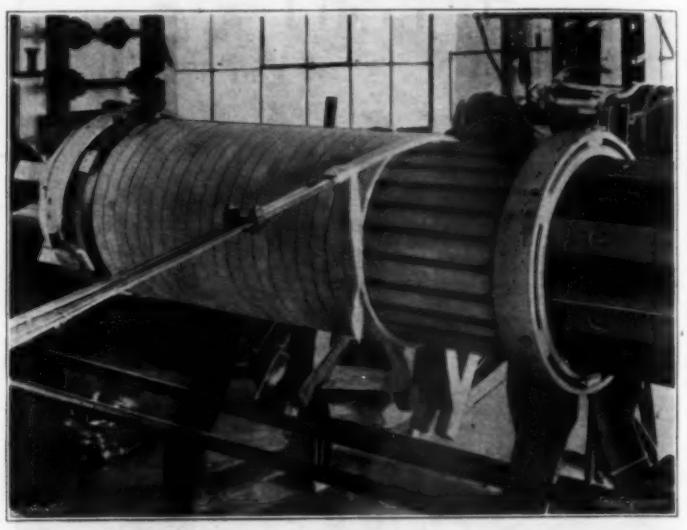


FIG. 111—SECONDARY WINDING—BRITISH ELECTRIC TRANSFORMER CO.

THE BRITISH LIGHTING AND IGNITION COMPANY, LIMITED (VICKERS, LIMITED).

The British Lighting and Ignition Company (proprietors, Vickers Limited) is showing electrical equipment for aircraft, and some stationary armature magnetos, as described in our issue of October 13th, 1922. The company's aircraft dynamos are shunt wound and the voltage is maintained constant by means of an automatic regulator, which works on the Tirrill principle. The dynamos are designed to be driven by an air screw, which is mounted on an extension of the armature shaft, but if desired they may be driven from the engine. The air screws are proportioned to suit all commercial flying speeds. They are made of selected walnut and are laminated. A drawing of one of the regulators for these aircraft dynamos is shown in Fig. 112. When the generator commences to excite, the shunt field winding is connected across the brushes through closed contacts. When, however, the voltage exceeds a predetermined value, the coil M causes the electro-magnet to pull down the vibrator arm V against the tension of the spring S, thus opening the contacts and connecting a resistance R in series with the field. This causes the voltage to fall, and as soon as it has reached a predetermined value the coil M releases the vibrator, thus short-circuiting the resistance. If the speed of the generator continues to be greater than that which is necessary to produce the required voltage, this operation is repeated. To reduce sparking to a minimum, a condenser is connected across the contacts. The weight of this type of regulator is 3 lb. 7 oz.

A switch-box for the control of navigation and anchor lights is constructed on very robust lines, and its weight is 13 oz. The aircraft cut-out—shown in Fig. 113—has two windings, a shunt winding connected across the positive and negative leads for the purpose of closing the contacts when the voltage has reached a pre-determined value, and a series winding connected between the generator and the battery. As soon as the latter commences to discharge through the generator the cut-out opens and breaks the circuit. The weight of this component is also small. All the instruments supplied for use with these aircraft equipments are of the moving coil type, whilst the cables are made in accordance with the British Electrical Standards Association.

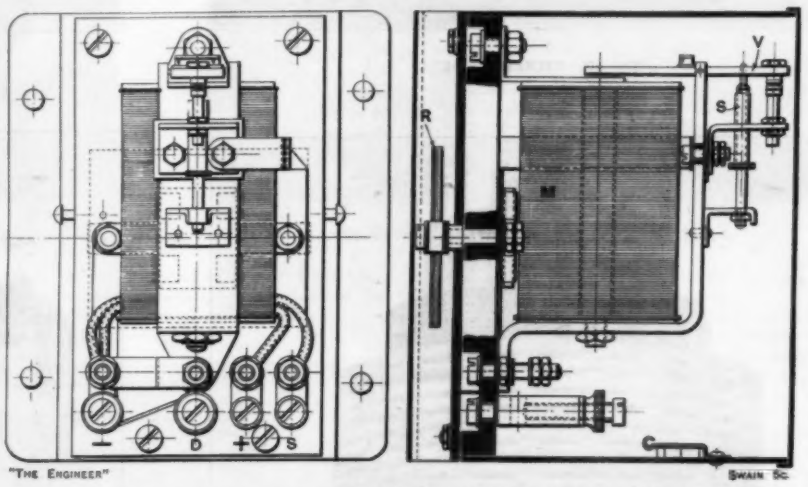


FIG. 112—VOLTAGE REGULATORS—BRITISH LIGHTING AND IGNITION CO.

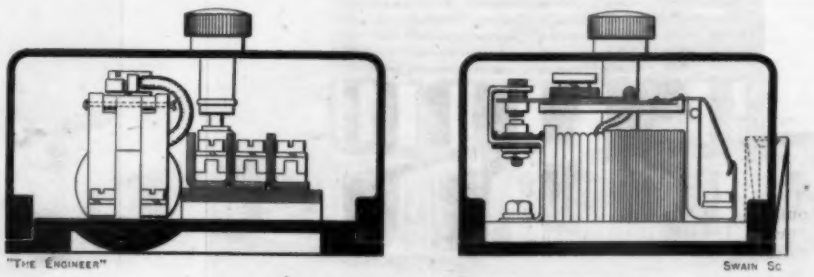


FIG. 113—AIRCRAFT CUT-OUT—BRITISH LIGHTING AND IGNITION CO.

WOOD-WORKING MACHINERY.

It is to be feared that those visitors to Wembley Park who may expect to find there a representative selection of everything that the Empire can do in the way of wood-working machinery will be disappointed. Although there are several machines in various parts of the Palace of Engineering and a few more are to be found elsewhere in the Exhibition, they cannot in any sense of the word be regarded either as an adequate representation of Britain's potentialities in this respect or of the firms which have been mainly responsible for the high reputation that for years has been possessed by British wood-working machinery all the world over. It is understood that some of these makers intend to make a comprehensive display at the Machine Tool Exhibition at Olympia in September.

MATTHEW WYLIE AND CO., LTD.

Nevertheless, among the few machines shown there are several that are of good quality and worthy of notice as containing novel or interesting features. Foremost among them is a selection of special machines for doing certain operations in connection with box-making, exhibited by Matthew Wylie and Co., Limited, of Glasgow. This firm is showing several box-nailing machines with all the most recent adjust-

ments. All are run at a high number of strokes per minute, and on certain of them as many as twelve nails can be driven simultaneously, either in a straight or a zigzag line. All are built on the "visible" principle, which permits the operator to see that the whole of his feeding tracks are full of nails, thus giving ample warning before any of the hoppers, into which the nails are poured, require replenishing. The two most interesting of these nailing machines are one which drives two right-angle lines of nails simultaneously so that the lids and bottoms of boxes may be affixed in two instead of four operations, and one for nailing the cleats or battens on to boxes and clinching the nails simultaneously.

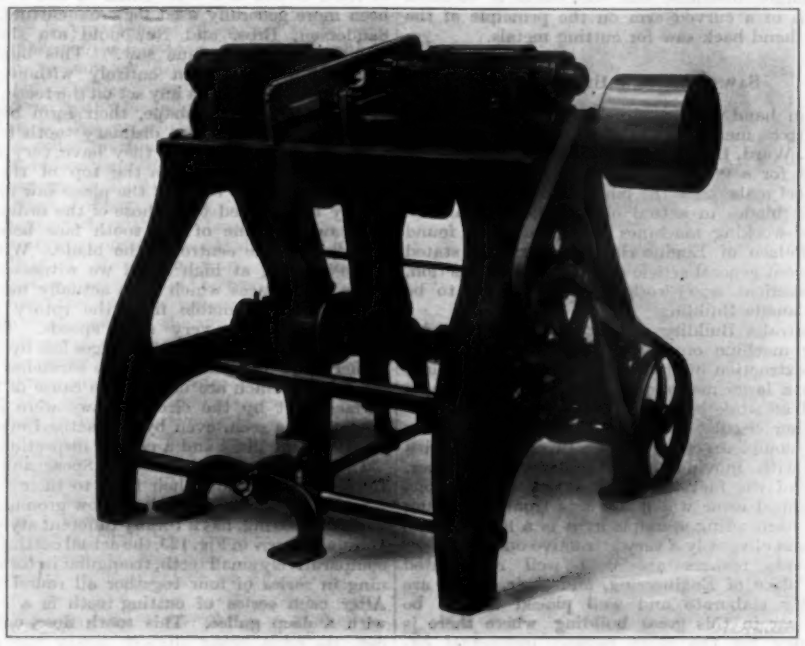


FIG. 114—AUTOMATIC HAND-HOLE BORING MACHINE—MATTHEW WYLIE AND CO.

A most ingenious and novel machine on this stand is the high-speed automatic hand-hole boring machine—Fig. 114—which can turn out nearly 800 box hand-holes in an hour. The "hand-hole" of a box is in reality a curved slot-mortise passing right through the material, and this machine cuts this mortise in one operation. The curve of the mortise is the true arc of a circle, the radius of which is determined by a rocking lever with an adjustable fulcrum. The cutting tools advance automatically into the wood on both sides of the board, meeting and completing the cut in the centre of the material, and thus avoiding any of that splintering which is inevitable when a tool runs right through the wood. By an ingenious design of the cutters used, which are made on the male and female principle, they meet and impinge on each other but do not actually come into contact. The board is placed against a vertical fence, where it is seized instantaneously and automatically by two cramps. Simultaneously the two cutters move forward towards each other and the board is traversed with a rocking movement to the length of the mortise required until the hole is completed, when it is immediately released. The actions of the cutters, the cramps and the rocking of the board are all effected and governed by a series of cams below the table. This firm also shows a simpler machine of the non-automatic type for boring hand-holes. Another machine on this stand which is worthy of notice is an automatic two-colour box printing machine—Figs. 115 and 116—which is very rapid in action and is hopper-fed.

MONNINGER AND CO.

Messrs. Monninger and Co., of London, who are more generally identified as specialists in band and circular saw blades, and in apparatus appertaining thereto, are showing a complete line of these things, including sharpening, setting and brazing machines, and, also, a wide range and considerable variety of those safety appliances for wood-working tools which are so dear to the factory inspector in these days. Great ingenuity has been exercised in the design of some of these appliances, which have been made to fulfil Home Office regulations without being too cumbersome or difficult of adjustment. This firm is also showing some small wood-working tools, notably a hand-feed planer, a vertical spindle irregular moulding machine, and a rod-rounding machine, all of which are of the "bench" type, *i.e.*, can be fixed to any bench, table or pedestal which may suit the purchaser's convenience. Such machines are becoming increasingly popular among users whose work is all small and of great variety, such as fine cabinet work or small pattern or model making. The hand-feed planer has a feature which we have not seen before, at all events in so simple a form. This is an apparatus carrying an inverted upper table bolted to the top of the machine, which has the effect of transforming the machine from a mere surface planer into a thicknessing machine. To make the change the front table is lowered considerably below the level of the back table, as shown in Fig. 117, and to the top of it is screwed a false table fitted underneath with four vertical spiral springs. Above it is the inverted table, the height of which above the back table determines the thickness to which the wood is to be reduced as it passes through the machine. That thickness is varied by a screw arrangement which lifts or lowers the top inverted table. The material to be thicknessed is pushed by hand between the top and the bottom table, the latter adjusting itself automatically by means of its springs to accommodate wood of varying thicknesses.

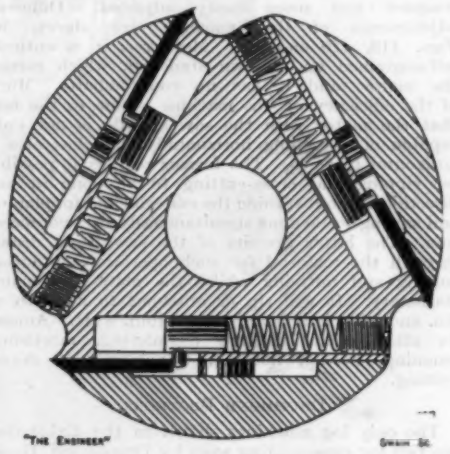
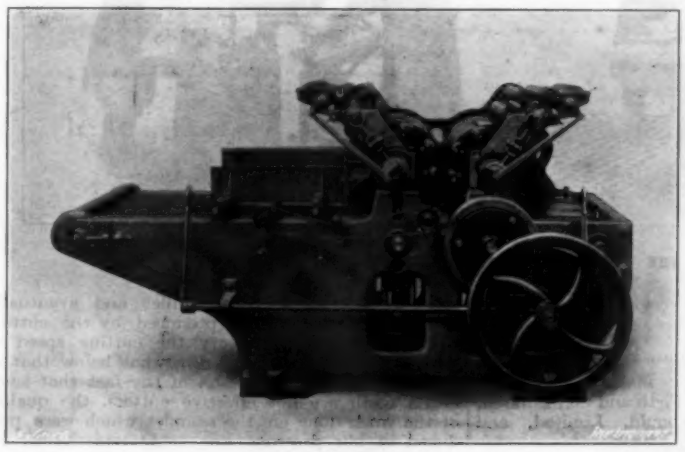
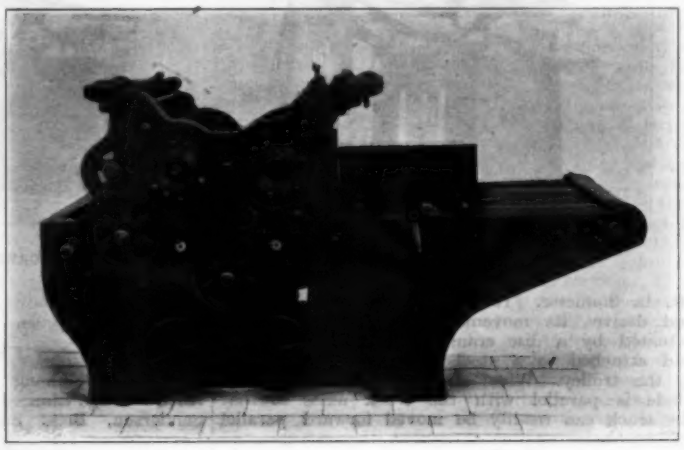


FIG. 118—"CLIMAX" THREE-CUTTER SAFETY BLOCK





FIGS. 115 AND 116—AUTOMATIC TWO-COLOUR BOX PRINTING MACHINE—MATTHEW WYLIE AND CO.

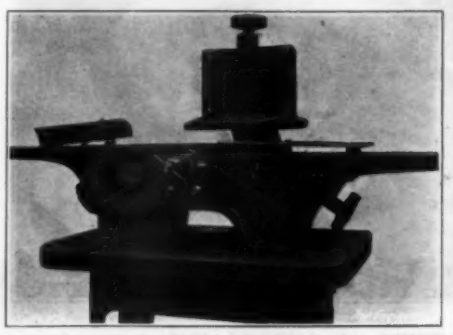


FIG. 117—HAND-FEED PLANER—MONNINGER AND CO.

The other most noteworthy machine on this stand is an automatic filing machine for small band saw blades, which possesses the novel feature of not using any floor space whatsoever. The machine, which is very compact, is bolted either to a wall or to any upright in the factory, whilst the band blade—which in other machines is usually supported on a pair of horizontal pulleys many feet apart and using a great amount of floor space—is slung from a roller high above the machine and no part of the blade touches the floor.

Messrs. Monninger are also showing one of their new "Climax" three-cutter safety blocks for hand feed planers. The feature of this block which differentiates it from the ordinary types is the arrangement of its series of cutter-ejecting springs which has the effect of reducing to a minimum the skill, effort and time occupied in setting. Each spring, which is spiral, acts upon a short rod or plunger placed in a hole drilled in the cutter-block below the cutter seating, as shown in Fig. 118. This plunger carries a pin projecting upwards into a space behind the cutter and presses automatically against the back of the cutter. Thus the springs tend to eject the cutter as soon as the cramp screws are slacked. All then that is necessary to effect the setting is to slacken the screws sufficiently to allow the cutter to advance until it touches the stops of the setting apparatus and to re-tighten the screws without any further adjustment.

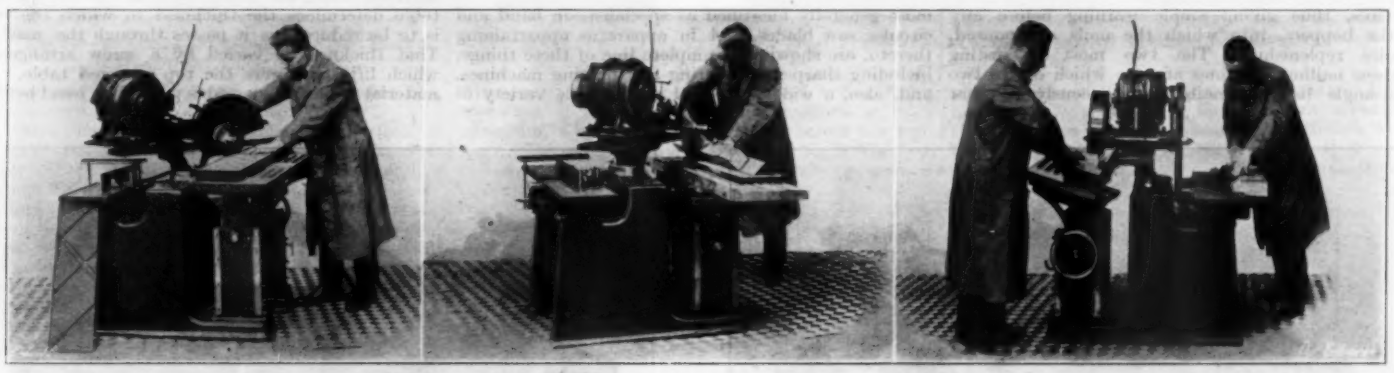
DOMINION MACHINERY COMPANY.

Next in importance comes the exhibit of the Dominion Machinery Company, of Halifax, which also specialises in the smaller types of wood-working tools. This firm is showing a chain-cutter mortising machine, a plain 30in. band saw, a vertical spindle moulding machine, a combined vertical moulder and fret saw, and an "Elliot" woodworker. The last machine is the most interesting of the exhibits on this stand as, while performing most of the lighter operations of the old-fashioned and complicated machines of the "general joiner" type, it is far more compact and more easily adjusted. Different adjustments of this machine are shown by Figs. 119, 120 and 121. Moreover, it is entirely self-contained on its own standard, which carries the motor, and it has no countershafts. Much of the efficiency of this machine is due to the fact that the motor with the saw spindle is not only capable of swivelling horizontally, but has also a horizontal traverse. The former renders it possible for ripping and cross-cutting to be done in one direction without turning the material and for planing and sawing to be done simultaneously by two operators. The latter permits of the saw being drawn through the material for such operations as cross-cutting and mitreing whilst the material remains stationary. It will rip or cross-cut to a depth of 6in. and will plane boards up to 10in. wide. Among its other operations are chamfering, mortising, tenoning, boring, housing, trenching and mitre-cutting.

DRUMMOND BROTHERS.

The only log machines shown in the Exhibition are two log cross-cutting saws by Drummond Bros., of Guildford. Both of these machines are complete and self-contained with their paraffin engine, and are mounted on trolleys to facilitate moving. The larger one, illustrated by Fig. 122, is for general saw mill or forestry work, and carries a blade from 6ft. to 10ft. long. It will cross-cut logs up to about 6ft. in diameter. It is of the reciprocating type, and derives its movement from a rocking arm actuated by a disc crank through a link motion and attached to a steel frame which is hinged to the trolley. When the saw is working the blade is parallel with the truck axles so that the truck can readily be moved forward parallel with the log after each cut. The length of the stroke can be altered by means of an adjustment on the link gear which actuates the rocking bar. Except that the teeth of the blade are of the vertical, or "peg" type, similar to those of the hand cross-cut saw, instead of being "raked" towards the machine, this saw effects its work very much in the same manner as do the reciprocating cross-cut machines of the steam and crank types, and, like theirs, its blade is unstrained.

The smaller machine, which is described as for "estate work," deals only with logs up to about 12in. in diameter. The teeth are similar to those of the larger machine, but the blade is strained by means of a curved arm on the principle of the ordinary hand hack saw for cutting metals.



FIGS. 119, 120, AND 121—DIFFERENT OPERATIONS PERFORMED BY THE "ELLIOTT" WOODWORKER—DOMINION MACHINERY CO.

FIG. 122—RECIPROCATING LOG CROSS-CUTTING SAW—DRUMMOND BROS.

SAWS AND SAW BENCHES.

A plain band saw, a circular saw bench and a chain-cutter mortising machine, are shown by Thos. W. Ward, Limited, of Sheffield.

Except for a few sawing machines used by some of the steel makers for the purpose of demonstrating their saw blades in actual operation, these are all the wood-working machines that are to be found in the Palace of Engineering although, as stated in our recent general article on the Canadian Section, a few excellent wood-working machines are to be seen in Canada Building.

In Australia Building also are to be seen an interesting machine on the winch principle for the forcible extraction of the roots of trees after felling, and also a large mechanical panoramic model of a saw mill at work in a forest. The latter contains a revolving circular rack bench with its travelling carriage complete engaged in sawing logs, and a railway with moving trains transporting timber. In spite of the fact that this model contains one bad technical error which detracts from its virtues from an engineering standpoint, it is a fine realistic display and obviously a very attractive one.

Saw-blade makers are very well represented in the Palace of Engineering, and their stands are sufficiently elaborate and well placed not to be passed over in this great building. where there is a tendency for the more modest individual exhibitor to find himself dwarfed or overshadowed by the colossal shows of the very big firms and by the collective stands.

FINE-SAWING.

Prominent among the saw makers are Edgar Allen and Co., Limited, Thos. Firth and Co., Limited, Sanderson, Bros. and Newbould, Limited, and Spear and Jackson, Limited, all of Sheffield. Both of the two last named are showing in operation special circular blades for producing a perfect surface on the sawn work. In other words, their ambitious object is to dispense altogether with the planing machine for finishing the work. The results are so wonderfully good in both cases as to make them, in some respects, the most remarkable of the wood-conversion exhibits in this Exhibition. Certainly the smooth surfaces obtained will come as a revelation, even to many experienced users of machines, as to the capabilities of the circular saw blade for fine cutting. In both cases these results are primarily due to the use of a hollow-ground blade, which in itself is not new but which in this country has been more generally used for cross-cutting. Messrs. Sanderson, Bros. and Newbould are showing for this work their "plane saw." This blade which, like the other, is run entirely without packing, and, of course, without any set on the teeth, has teeth of uniform size and shape, their form being much the same as that of an ordinary tooth for ripping hard woods, except that they have very much less "rake" and the bevel on the top of the tooth is more acute. The teeth of the plane-saw are, in fact, hardly more raked than those of the ordinary cross-cut saw, the line of the tooth face being almost radial from the centre of the blade. With such a blade running at high speed we witnessed samples cut with surfaces which were actually more perfect than those obtainable from the rotary planer at anything beyond very slow speeds. They were better because the inevitable ridges left by the rotary planer were not there, and the scratches made by the teeth—which are usually the cause of the rough surfaces left by the circular saw—were so minute as not to be seen, even by a practised eye, without a magnifying glass and a careful inspection.

In opposition to this device Spear and Jackson, Limited, are pinning their faith to their "Novelty" saw blade which, though hollow-ground and run without packing, has a totally different style of tooth. Here, as shown in Fig. 123, the actual cutting is done by comparatively small teeth, triangular in form and running in series of four together all round the blade. After each series of cutting teeth is a long tooth with a deep gullet. This tooth does not actually cut, its edge being slightly below the peripheral track of the cutting teeth, and its function is to accommodate in its deep gullet and eventually to discharge the sawdust produced by the cutting teeth. Although in theory the cutting speed of such a blade ought to be somewhat below that of the "plane-saw," by reason of the fact that some of its teeth are not effective cutters, the quality of the work done on the samples which were produced in our presence was truly remarkable, for the samples in question, sawn on all four sides and cross-cut at each end, had the appearance of wood that had been accurately and highly finished by fine sand paper. A tribute to the perfectly straight cutting of both these rival blades was afforded by using a sample cut by one as a straight edge for testing the accuracy of the other. This we did, and failed to detect the slightest deviation from the straight line on any of the sides or in any direction on either sample.

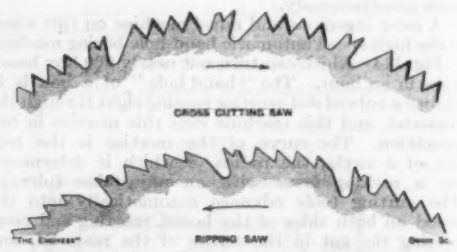


FIG. 123—"NOVELTY" SAW BLADES—SPEAR AND JACKSON

In each case the blade used was rather thicker than that of an ordinary saw of the same diameter. This, however, occasioned no extra waste of wood, because the side-set on the teeth of the ordinary saw brings the width of the saw-cut up to that made by these special blades which have no set.

THE MACHINE TOOL TRADE ASSOCIATION.

Although none of the big makers of wood-working machinery are showing their machines, they are

in a manner represented collectively. Pushed away in a sort of *cul-de-sac* in the remotest corner of the Palace of Engineering and right off the beaten track as represented by the long "avenues" and their right-angle "bays," is the stand of the Machine Tool Trades Association. That organisation has among its members not only a great many of the makers of machine tools, but, we understand, all of the best known makers of wood-working machinery in the country. On the walls of the Association's stand, which is virtually an office, are to be seen scores of pictures of the latest wood-working machines made by its members. And there is a complete library of the catalogues and other trade publications connected with the industry. This, however, is all that is to be seen in this great Exhibition of the wood-working machinery made by such firms as Thos. Robinson and Son, John McDowall and Son, A. Ransome and Co., Wadkin and Co., Thos. White and Sons, J. Sagar and Co., and others whose names in connection with this branch of the engineering industry are household words all the world over.

This policy of abstention from exhibiting at Wembley was, we understand, arrived at by agreement between the makers concerned for various reasons, of which one was the difficulty of showing modern high-speed sawing and planing machines adequately in operation at any Exhibition on account of the enormous amount of material that must be brought in and out of the Exhibition, even if such machines were to be at work only for a short time on each day. We cannot, however, help thinking that it would have been a good thing for everybody concerned if those firms had followed the example of the makers of textile machinery, who have erected between them a very complete textile mill in which all the machines are by the different makers, the whole forming one of the most instructive and popular exhibits in the Palace of Industries. A collective saw mill or a joinery works would have been equally attractive, and would have given our overseas visitors, many of whom come from timber countries, a good general idea of what British firms are doing in this way.

GENERAL ENGINEERING EXHIBITS.

A. G. MUMFORD, LIMITED.

On the stand of A. G. Mumford, Limited, of Colchester, there is a representative display of pumps and steam auxiliaries for marine and land work. A full sized boiler end is exhibited, and on it is arranged the Mumford patented type of automatic feed-water regulator. This useful device will doubtless be familiar to most of our readers, and we need not describe it again in detail, but we note with interest that feed-water regulators of this type have now been fitted to the boilers of over 700 vessels, representing an aggregate of 11,250,000 indicated horse-power, and including such important liners as the Majestic, Berengaria and the Empress of Australia. Similar regulators designed for naval service have been supplied for the boilers of more than 500 naval vessels, including the H.M.S. Hood, the largest battle-cruiser in the world. We have singled out for special mention three types of marine pumps, which represent the firm's standard practice in connection with the engine-room auxiliaries of modern passenger and cargo-carrying ships. These are the Simplex feed pump, the twin air pump, and the electrically driven transfer pump for oil or water.

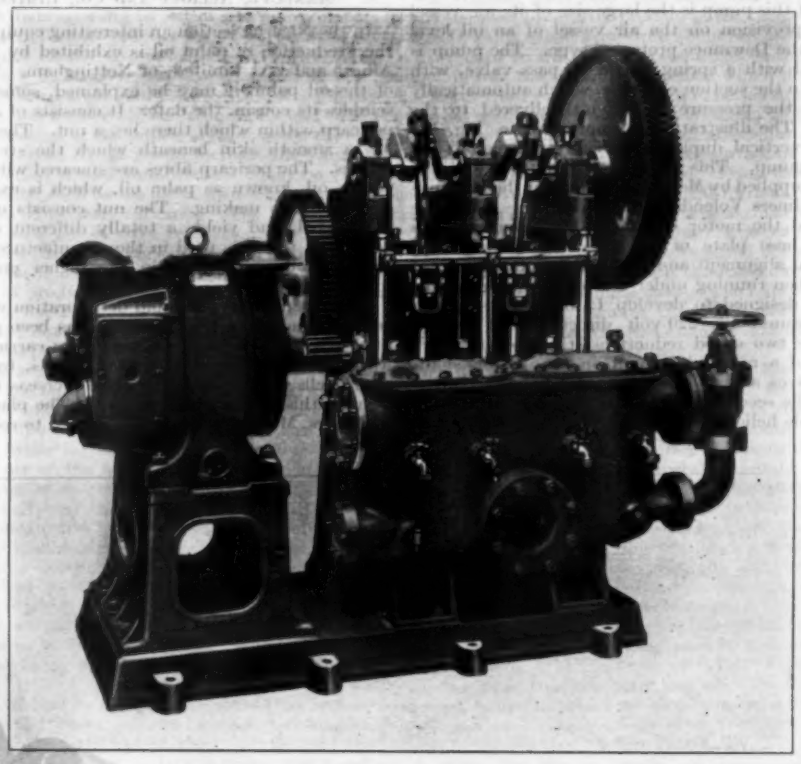
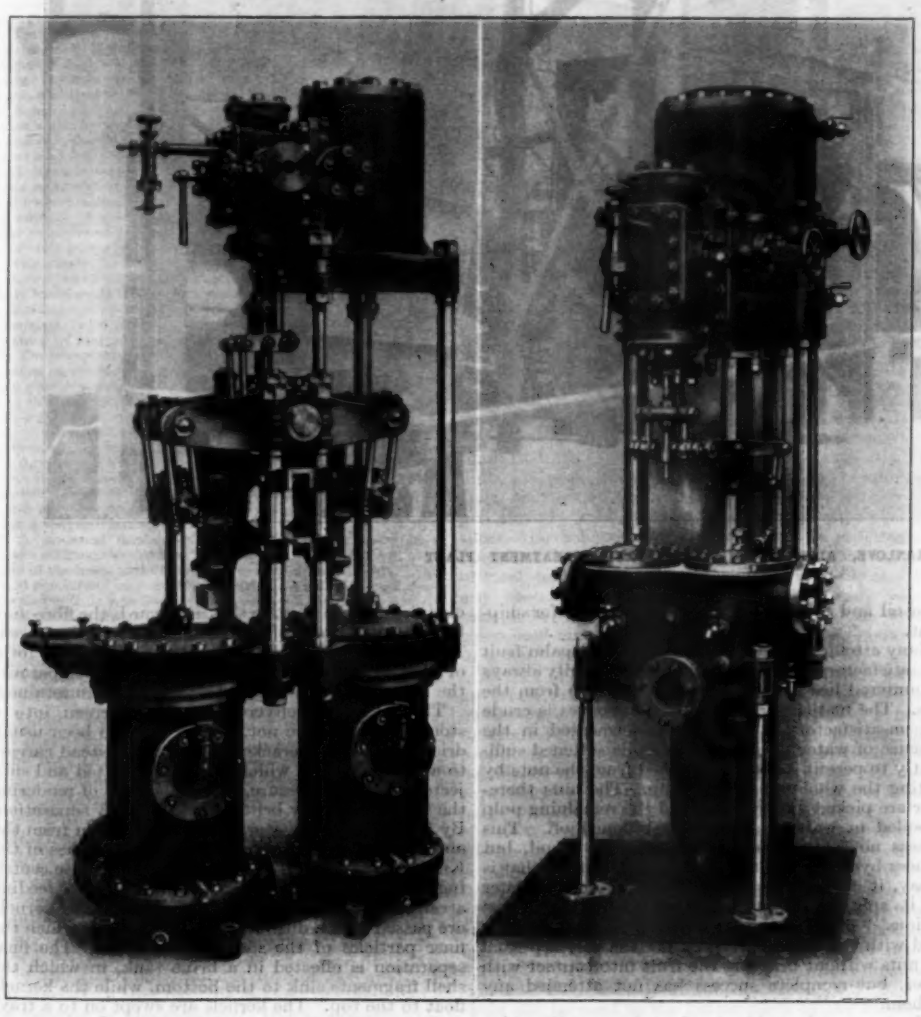


FIG. 126—ELECTRICALLY-DRIVEN OIL FUEL TRANSFER PUMP—MUMFORD



FIGS. 124 AND 125—TWIN AIR PUMP AND DIRECT-ACTING FEED PUMP—MUMFORD

The vertical "Simplex" direct-acting feed pump is illustrated in Fig. 125. The steam cylinder is furnished with Mumford's patented valve gear, in which the steam distribution is controlled by an ordinary D slide valve, which is operated by a vertical shuttle valve. Three turned steel columns of large diameter support the steam cylinder and connect it rigidly with the pump end. The gear for operating the valve motion is constructed throughout from steel forgings, which are finished bright. A feature of the design is the provision of adjustable gun-metal bushes of large size on all working shafts, a practice which facilitates adjustment and promotes reliability of running over prolonged periods of service. The piston-rod for the steam cylinder is steel, and is connected to the rolled naval brass pump rod by a forged steel split coupling, to which the gear-operating levers are attached. A cast iron pedestal type of pump body, with the pump valve chests forming part of the main casting, is used. The suction and delivery valves, which are in two groups, are of the flat plate type, with bronze springs. All necessary steam valves are fitted, including gun-metal steam and exhaust valves, as well as pet cocks and drain valves. The pump scantlings are extra heavy, and are designed, we are informed, to withstand the full pressure load to which the pump can be subjected when the steam stop valve is opened full and the boiler check valve closed. The pump shown on the stand is of the same design as those which the firm has supplied to sixteen of the most recent Holland-America Line passenger and cargo vessels for Atlantic service. The makers state that pumps of this type can be supplied in capacities from 270 gallons per hour up to 13,000 gallons, and for all boiler pressures. A similar type of pump is also built for ballast and oil transfer duties.

The vertical twin type air pump, illustrated in Fig. 124, is also fitted with a single "Simplex" steam cylinder, which operates double air pumps by means of rocking levers with adjustable links. The rocking levers are supported on forged steel columns, to which in turn the pump crosshead guides are attached. The same columns serve to carry the rocking lever bearings and two of the columns are extended to form a support for the steam cylinder, which is also bolted to a back column connected directly to a lug on the pump barrel casing. The pump barrels are made of gun-metal, while the suction and discharge chambers are of cast iron, and valves of the Kinghorn type are employed. Access to the valve chamber is given by inspection doors on each pump barrel. An interesting point in connection with the steam cylinder is the provision of compression control valves, whereby smooth running is obtained under all conditions of load. Air pumps of the kind we have described are built in a range of standard sizes with air duties designed for machinery

of from 500 indicated horse-power up to 10,000 horse-power.

Another prominent exhibit is the Mumford vertical "Simplex" oil fuel pressure pump for supplying fuel oil under pressure to the burners. A noteworthy feature of this pump is the large size of its air vessel and the provision on the air vessel of an oil level gauge of the Dewrance protected type. The pump is also fitted with a spring-loaded by-pass valve, with a return to the suction chamber, which automatically regulates the pressure of the oil delivered to the burners. The illustration we reproduce in Fig. 126 shows a vertical duplex electrically driven oil fuel transfer pump. This pump is a duplicate of those recently supplied by Messrs. Mumford for the Holland-America liners Volendam and Veendam. Both the pump and the motor driving it are mounted on a common base plate of robust construction, which gives good alignment and prevents any displacement of line when running under service conditions. The motor is designed to develop 12 brake horse-power and is wound for 220-volt direct-current supply. There are two speed reductions, the first of which consists of a raw hide pinion on the motor shaft, which drives a cast iron spur wheel on a counter-shaft. The second reduction is obtained by the use of a double helical steel pinion on this shaft, which engages with a cast iron spur wheel on the pump crank shaft. Both the crank shaft and the connecting-rods are of steel and the crossheads are of cast steel, with large cast iron guide faces running in adjustable guides. The gun-metal bearing bushes are of large dimensions, and are adjustable and fitted with drip lubrication, while the main bearing on the motor shaft is ring lubricated. All the pump valves are made of steel and work on cast iron seats, specially large ports being introduced so that the resistances are reduced to the minimum. A by-pass valve, with a hand control and a suction return, facilitates easy starting. The pumps, we understand, are built in various standard sizes up to capacities of 200 tons per hour, and, in addition to the type we illustrate they may be supplied with a silent worm drive. This type of pump may also be used for bilge, ballast and fresh water pumping, and when fitted with a submersible motor, it is also useful for emergency bilge service.

Among the various other pumps to be seen on the stand is a large type Mumford duplex feed pump, with the latest valve gear, and a duplex brine pump. A large horizontal low-pressure duplex pump is also shown, as well as a number of small horizontal pumps and vertical wall type "Favorite" donkey pumps, which are a well-known Mumford product. The machinery exhibited shows that the new developments which have been made in connection with oil-burning and turbine-driven vessels have been considered and the requirements met.

Manlove, Alliott and Co., Limited.

In the Nigeria Section an interesting equipment for the production of palm oil is exhibited by Manlove, Alliott and Co., Limited, of Nottingham. The fruit of the oil palm, it may be explained, somewhat resembles its cousin, the date. It consists of a hardish pericarp within which there lies a nut. The pericarp has a smooth skin beneath which the structure is fibrous. The pericarp fibres are smeared with a thick yellow oil, known as palm oil, which is extensively used for soap making. The nut consists of a shell and kernel, and yields a totally different oil, palm kernel oil, which is used in the manufacture of soap, candles and paint, and, in the higher grades, for edible purposes.

Consequent upon the rapid deterioration which the pericarp undergoes after the fruit has been gathered, the recovery of palm oil is commonly carried out in Africa at the plantations. The kernels, freed from their shells, are generally shipped overseas for treatment in this country or elsewhere. The plant shown by Messrs. Manlove, Alliott is designed to recover the palm oil and to separate the kernels ready for shipment.

Many attempts have been made to treat palm fruit in a satisfactory manner, but the chief difficulty always encountered lies in separating the pericarp from the nuts. The method practised by the natives is crude and unsatisfactory. The fruit is fermented in the presence of water until the pericarp is softened sufficiently to permit its being detached from the nuts by beating the whole mass to a pulp. The nuts thereafter are picked out by hand and the remaining pulp is boiled in water and the oil skimmed off. This process not only results in a large loss of oil, but induces hydrolysis in that which is obtained—that is to say, it causes the absorption by the oil of water and its splitting up into free fatty acid and glycerine. Various "dry" processes have been proposed or tried with the object of separating the pericarp from the nuts without bringing the fruit into contact with water, but complete success has not attended any of them.

The process adopted in the plant shown at Wembley by Messrs. Manlove, Alliott is not a dry one. It is claimed, however, to give a better yield of oil than is obtained when the pericarp is separated from the nuts and subsequently treated in hydraulic presses. A recent analysis, we are informed, showed that after treatment in the Manlove plant, the fibre contained not more than 3 per cent. of oil. General views of the plant are given in Fig. 127 and on page 570. The fruit as received at the factory is raised by an elevator and delivered into a digester capable of dealing with 1 ton of fruit per hour. Inside the digester the fruit is subjected to steam pressure and to agitation in such a way as to ensure the complete separation of the fibre from the nuts. After remaining in the digester for thirty minutes, the charge, now consisting of pericarp, nuts and oil, is delivered into a centrifugal machine fitted with a steam spray, where it is received in a removable basket. In ten to fifteen minutes' time the action of this machine results in the oil being separated and drawn off, the nuts and fibre, together with a considerable amount of moisture absorbed by the fruit during the digesting process, remaining behind. The length of time during which the oil is in contact with the steam in the digester and the centrifugal machine, is, it is stated, insufficient to induce hydrolysis.

The basket is then removed from the machine and replaced by one freshly charged. Its nut and fibre contents are delivered to a rotary drying machine, which, as at the Exhibition, may be heated by means of the waste gases from the steam boiler attached to the plant. This drier removes the bulk of the moisture contained in the fibre, so that afterwards the fibre may be separated from the nuts on a revolving screen. The screen is composed of bars arranged in the form of a hexagonal cage and fixed at a pitch which permits the fibre to pass through while the nuts are retained.

The nuts are delivered from the screen into a storage bin, but are not, as has hitherto been usual, dried before being cracked. They are instead carried to an autoclave, in which they are agitated and subjected to steam pressure, with the object of rendering the shell sufficiently brittle to ensure easy separation. By means of an elevator the nuts are taken from the autoclave to cracking and separating machines of the Knox patented type. These machines operate centrifugally and are provided with an automatic feeding arrangement. Leaving them, the shells and kernels are passed over a dust-separating screen by which the finer particles of the shell are removed. The final separation is effected in a brine tank, in which the shell fragments sink to the bottom, while the kernels float to the top. The kernels are swept on to a tray, and thereafter are passed through a centrifugal machine with the double object of drying them sufficiently to permit their being immediately bagged and of recovering the major portion of the brine—an expensive item in the regions where palm oil factories are commonly established. The shell fragments are

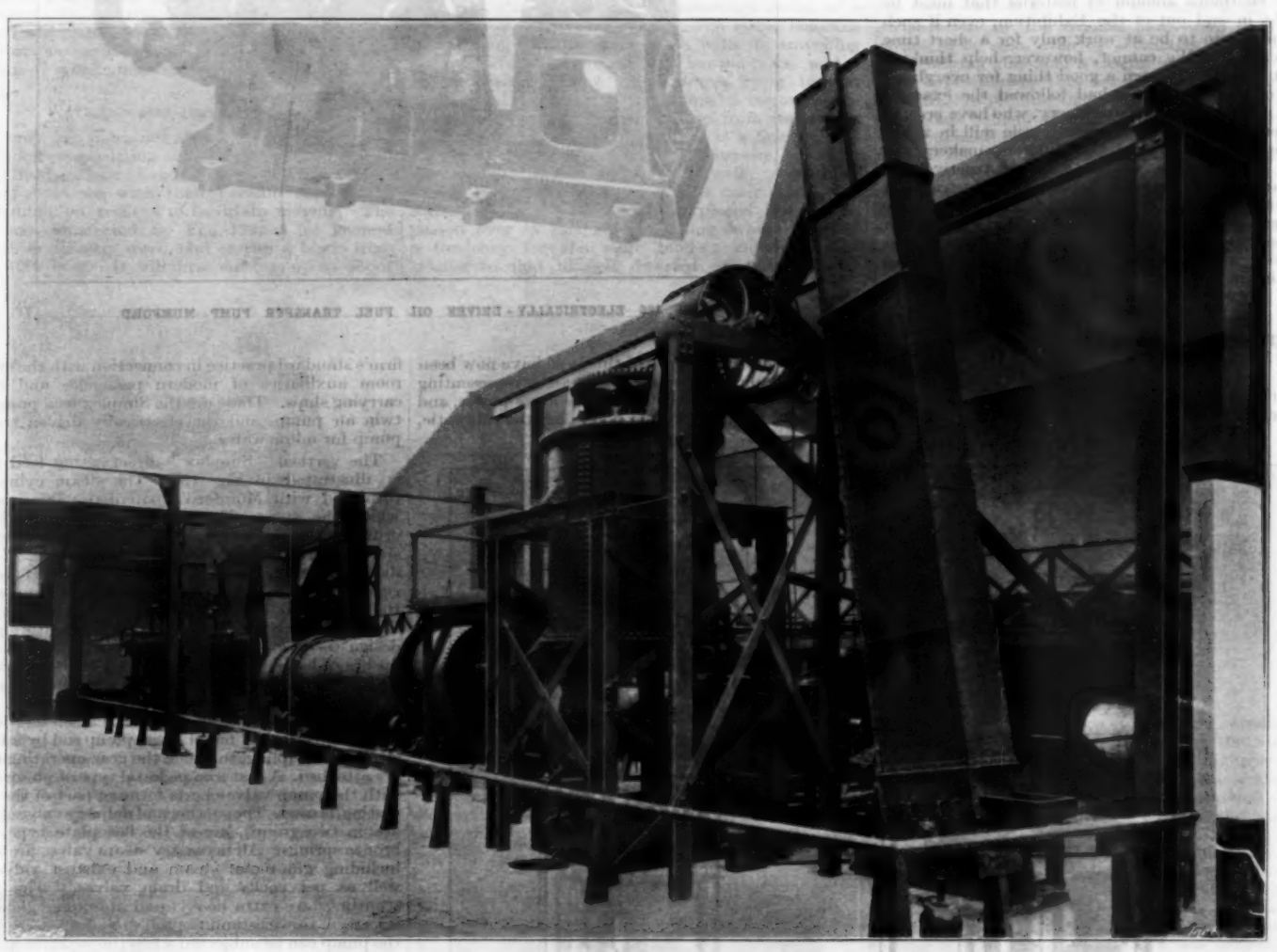


FIG. 127—MANLOVE, ALLIOTT'S OIL-PALM FRUIT TREATMENT PLANT

taken by a conveyor and elevator to another centrifugal machine, and may thereafter be used as fuel in a boiler.

The plant exhibited is part of an installation manufactured by the firm for the Nigerian Products Company, Limited, and when finally erected will have a capacity for 2 tons of fruit per hour. To this end it will comprise two digesters, each of 1 ton per hour capacity, and two nut-cracking machines, each capable of dealing with 1½ ton of nuts per hour. One cracking machine would be sufficient to handle the output of both digesters, but the machines are duplicated in order to guarantee continuity of working. We are informed that the plant can be supplied to suit all outputs down to 1 cwt. an hour.

Iron and Steel Institute.

No. II.*

SIR WILLIAM ELLIS presided when the meeting of the Iron and Steel Institute was resumed on May 9th at the Institution of Civil Engineers.

Mr. W. Dyrssen presented a paper on "The Recovery of Waste Heat in Open-hearth Furnace Practice," from which we reprint the author's summary.

RECOVERY OF WASTE HEAT.

1. A complete detailed heat balance of fuel for a modern American 80-ton producer gas open-hearth furnace is given. This balance shows that in good practice the waste gases from the chequer chambers contain about 43 per cent. of the heat in the fuel, and that by the use of a waste heat boiler about 25 per cent. of the heat in the fuel can now be recovered in steam.

2. A study is made of this heat balance, which shows that by the insulation of chequer chambers and flues and by using valves with a small amount of water cooling, and by preventing an excessive amount of air from entering the chequer chambers and flues, the steam output can be raised to correspond with about 34 per cent. of the heat in the fuel.

3. It is shown that the heat actually used by the bath, in addition to the chemical and sensible heat in the charge itself, is small compared with the heat in the fuel, and is in ordinary practice, with hot pig iron, less than about 8 per cent., and with cold pig iron between 10 to 15 per cent. of the heat in the fuel. The total heat losses from the open-hearth furnace system constitute, therefore, from 90 to 92 per cent. in the ordinary hot pig iron process, and from 90 to 85 per cent. in the cold pig iron process, of the heat in the fuel.

4. Constructional changes in the open-hearth furnace, making it possible to obtain a still higher output of steam, have been considered. In the case of producer gas the elimination of the gas chequer chambers is considered. It is pointed out that in many furnaces to-day the heat actually added to the gas in the chequers is small and that in such cases the gas chequers could be dispensed with, without increase in fuel consumption, and a gain in steam output would be the result.

5. The proposed practice of taking part of the waste gases from the melting chamber direct to the boiler is discussed, and it is shown that the heat in the waste gases from the melting chamber is far in excess of that required for preheating the air and gas, and that this proposed practice is fundamentally sound.

6. A heat balance is given for a producer gas open-hearth furnace with the constructional changes mentioned in (4) and (5), and it is shown that as much as 40 per cent. of the heat in the fuel may be recovered as steam.

7. A heat balance for a coke oven gas-fired open-hearth furnace is given for comparison with producer gas as fuel, and it is shown that in percentage of the heat in the fuel about the same amount of steam can be produced from both fuels under similar conditions, but that the steam production per hour is less for coke oven gas.

8. The steam output for various charges is discussed, and it is shown that with an all-cold charge the steam output is only slightly less than with hot pig iron in the charge.

9. Further increase of steam output by the use of economisers is discussed; also a method for the recovery of radiated heat from the roof and port ends.

10. The construction of an open-hearth furnace, working according to the methods proposed in (4) and (5), is considered from a practical point of view. A practical method of diverting part of the extremely hot gases from the melting chamber direct to the boiler without the use of valves and without large heat losses is given, also construction of port ends and chequer chambers.

11. A comparison between blast-furnace and open-hearth practice is given, and it is shown that in average practice in steel plants the amount of steam obtainable from surplus blast-furnace gas and from waste heat in open-hearth furnaces is of about the same magnitude.

12. A practical method of cooling down the waste gases from the melting chamber to the chequers when required, or at the end of the heat, without the loss of heat units, is given. This method consists of introducing the proper amount of cool gases at the proper time into the waste gases in such a way as to protect the brickwork without the use of air or water cooling, and this method would give a higher average temperature to the combustion air during a heat without undue damage to the port ends and downtakes.

13. The economic value of the recovery of waste heat in steam in open-hearth practice is discussed.

In the discussion Mr. Lindsay Foster expressed his great interest in the paper. The point made by the author was the use of waste heat for steam-raising purposes. The question raised was bound up with that of getting refractories which would stand up to the heats which had to be employed. If better types of refractories were available, it would not be necessary to waste so much of the heat in water cooling and other means. The idea of doing away with regenerators was very old, but he questioned whether the author had given full credit to the regenerative system. According to the figures given by Mr. Dyrssen, the gas reached his furnace at a temperature of 760 deg. Cent., but he did not say anything about the CO_2 in that gas, the amount of which had a great bearing on the question. It was possible that under the conditions which prevailed in the United States there was more scope for a system of the kind dealt with in the paper than would be the case in British practice. The whole question must be studied very carefully. There was always the risk that in an endeavour to overcome difficulties or to realise economies the furnace would become a more complicated apparatus, and that simpler methods which might provide a better solution would be overlooked. It was a little disheartening to reflect how many papers on open-hearth furnace practice had been read without any particular result. He welcomed the effort which had been made by Mr. Dyrssen to open up new ground.

Mr. Benjamin Talbot said the Institute was greatly indebted to the author for the trouble he had taken in the preparation of the paper, and for being present with them to read it. It would increase the value of the contribution if additional details could be given on some points, such as the exact form of the gas and air ports in American furnaces. The author had referred to the use of coke oven gas, and he (Mr. Talbot) hoped that it was the coming fuel for the open-hearth furnace. He had had twenty-five years' experience of producers, and wished to dispense with them. Coke oven gas was quite suitable to replace producer gas, but he would like to know whether in United States practice it was used stripped of benzol, by itself, or augmented with hydro-carbons. It was claimed by the author that, on the system advocated, the savings under average conditions represented from 100 to 150 per cent. per year of the cost of the waste heat boiler installation, and from 10 to 15 per cent. per year of the cost of the whole open-hearth plant. These were remarkable claims. He would point out, however, that the efficiency of the open-hearth furnace could be improved before embarking on a waste heat boiler scheme. Fuel consumption could be reduced by producing more steel in a given time. He had been experimenting with a new type of furnace in which the gas was not reversed, and it had given such satisfactory results that it had been decided to test it for finished steel. A model of this furnace was being exhibited at the British Empire Exhibition.

Mr. J. E. James referred to the three-pass regenerator. It would be of general interest, he thought, to know what was the life of the first pass and the type of bricks employed. It was neccessarg to ask whether the introduction of the cooling stream was an automatic process or if it was under the control of the melters. Attention ought to be given to the combustion end of the furnace, where there was an opportunity of effecting savings in fuel consumption. He had in mind the use of coke oven gas delivered at high velocities.

Mr. H. M. Ridge put forward the argument which had been raised by Mr. W. R. Ingalls some years ago, that a metallurgical furnace should be used for metallurgical purposes, and not with the idea of raising steam. A waste heat boiler would introduce an undesirable element into the operation of the open-hearth furnace. A point brought out in the paper was the extremely small percentage of the heat of the furnace which was used for its proper purpose. The object to be sought was to increase the intensity of the heat by preheating the air to the absolute limit. To achieve that object, it was necessary to go beyond the 760 deg. Cent. mentioned by the author as the temperature of the producer gas. The figures for heat losses given in the paper suggested that steps ought to be taken to reduce water cooling, and do as much as was practicable in insulating various parts of the furnace. The need for effecting fuel economies was generally admitted, but he believed that more direct methods were preferable to the use of a waste heat boiler.

Mr. E. H. Saniter said he could not accept the statement of Mr. Dyrssen that with a waste heat boiler it would be possible in the case of a modern plant making 1,000,000 tons of ingots to save 800,000 dollars a year. He had personally made a calculation, and in Great Britain the saving on the figures given would work out at 2s. per ton. He agreed with those who believed that the real line of progress in open-hearth furnace practice was to raise the output of steel, and not to raise steam from waste heat. In any case, the system advocated could only work satisfactorily with high temperatures of the waste gases, and not with gas at the temperatures common in general practice.

Mr. F. W. Paul referred to the conditions which governed the case when gas producers were working in close proximity to the furnace. That was a very different thing from the old system of placing the producers at a distance from the furnace. He had no hesitation in saying that as the result of his own experience it was possible to work regenerative furnaces without chequer work in the gas chamber.

Dr. W. Rosenhain pointed out that by merely accelerating the rate of flow of the gases a distinct economy in operation might be obtained. When that method was pushed to the limit, however, a jet of flame was blown down upon the bath, which was very hard on the furnace; but the rate of melting was increased and gave a greater number of heats during the life of the furnace. The question of insulation had been raised, but it had been said that it could not be used in the hotter parts of the furnace. That was a fallacy; heat insulation could be employed and was one of the directions in which economies were to be sought. The function of a steel furnace was, as other speakers had said, to make steel, and the test of a furnace was the quantity and quality of steel produced, and not the amount of steam raised from waste heat. A steel furnace used as a steam generator would be an indifferent piece of apparatus for the production of steel, and would not be a good steam generator.

Sir William Ellis said that steel makers did not want the steel to be a by-product of the furnace.

Mr. O. Frick asked a question about radiation losses. With regard to the Talbot system, the essential fact about it was the large bath surface which decreased the losses from radiation. From experiments carried out with a stationary furnace, a Wellman tilting furnace and a Talbot furnace, he had arrived at a figure for transmission of heat in the bath surface of 70 kilowatts per square metre of surface. From that figure he had built up a simple empirical formula of heat transmission in the open-hearth furnace. The formula would be useful in checking the character of heat losses. Two main points which required attention in open-hearth furnace work were the losses from heat radiation and from escaping gases. The improvement of the open-hearth furnace from the steel-making aspect was a sounder method than to add the complication of a waste heat boiler.

Dr. W. H. Hatfield argued that the loss arising from water cooling was the price paid for keeping maintenance charges at a low level. On the vexed question of using the waste heat, it could not be denied that when all possible use had been made of the heat available in making steel there would always be a surplus, and if gases were available at 600 deg. Cent. there was a case for the waste heat boiler. He had one general criticism to make of the open-hearth furnace; it was structurally defective if the test of being a relatively gas-tight structure was applied. There was a tremendous wastage of heat and loss of efficiency from gas leakage.

Sir William Ellis, in closing the discussion, to which the author will reply in writing, said he welcomed the paper as being of a most useful type. A practical contribution of that character was what the Institute required, and on behalf of members he desired to thank the author for coming over from the United States to lay his views before that meeting.

A paper by Mr. J. Seigle, of Nancy, entitled "Theoretical Considerations Respecting Certain Features in the Working and Efficiency of Reversing Regenerators," was then presented.

EFFICIENCY OF REVERSING REGENERATORS.

The question of the dimensions of open-hearth furnace or Cowper stove regenerators has been the subject of very numerous publications, but the results of different authorities have differed greatly, both in regard to the volume and weight of the chequer-work recommended in specific conditions, as well as in regard to the differences in the temperature of the brickwork between the period of the gas flow and the period during which it heats the freshly admitted fluids, and as to efficiency and temperatures reached by the heated fluids, &c. One of the factors in the problem of the general investigation of regeneration is an exact knowledge of the heat conditions prevailing in the interior of the chequer-work, the surface of which is subjected, as the result of reversals, to periodic temperature changes. If these conditions be known, the amount of heat stored up in the brickwork at any given moment can be deduced.

Another element in the investigation of regeneration is a knowledge of the laws of the heat exchanges between a gaseous fluid, either heating or being heated, and the bricks of the chequer-work. Views on this subject are still somewhat contradictory, although certain investigators accept, in this connection, Nusselt's results, according to which the rate of circulation exercises a marked influence on the rate of exchange. By employing, amongst others, the results obtained by the author himself in the course of his investigations, and making use of Nusselt's results, Mr. Noaillon, the manager of the Lecocq Coke Oven Company, in an interesting mathematical research, which has been published in the *Revue Universelle des Mines*,* has equated the problem of the distribution of average temperatures in fluids heating or being heated in a regenerator in the simplified case where the losses by radiation are neglected, and the average differences of temperature at the surface of the bricks during the periods of being heated and of heating are proportional to the average differences of temperature in the fluids heating or being heated, a calculation which the integration of differential equations renders possible. The present author, employing Mr. Noaillon's results, has sought to ascertain and to discuss the formulæ which show what influence any given change in certain characteristics of the working of a given regenerator would have on the working conditions and on the efficiency. He endeavours to show that certain relations which have been accepted in metallurgical investigations on the influence of the mass of the refractory bricks of the chequer-work, and on the amount of calories which are exchanged per square metre of heated surface, have been somewhat too roughly approximate. He does not, of course, believe that a regenerator can, so to speak, be "calculated," but conceives that it would be of extreme interest to secure well-ascertained facts for comparison.

Mr. W. M. Ridge said the thanks of the Institute were due to the author for an interesting contribution on a subject concerning which very little information was available. For that reason he would ask the Council of the Institute to consider whether some financial assistance ought not to be given towards further research work, which ought to yield extremely valuable knowledge. More information was required with regard to the bricks used in the construction of regenerators, as a very small change in the composition of the bricks was known to have a great influence on the conductivity.

Professor K. Honda, who was very warmly received, then presented a paper dealing with the "Forging Temperature of Steels."

THE FORGING TEMPERATURE OF STEELS.

It is well known that in the case of steel, forging is most effective at a certain favourable temperature, which should be neither too high nor too low. This temperature is called the forging temperature. To ascertain definitely what this temperature is, it would be necessary to know of a method for measuring the forgeability of a metal, but, unfortunately, no such method has

* No. I. appeared May 16th.

* June 15th, 1923.

as yet been discovered. The author believes that the forgeability may be measured by the elongation of the metal at high temperature, this being effected by means of a tensile strength machine. In such cases the elongation is effected by stretching the metal in the direction of its length, while in the case of forging it is caused by the compression applied in a direction perpendicular to its length. It appears at first sight that the elongations in these two cases are due to different mechanisms, but closer consideration shows that this is not the case.

The results of the present investigation may be summarised as follows:—In the case of carbon steels, the elongation-temperature curve has generally maxima and minima, and hence in the process of forging low carbon steels it is better to take every precaution against the fall of the temperature to 900 deg., where the elongation is at a minimum. In the case of medium carbon steels, this minimum is inconspicuous, so that the cooling of the specimen to 900 deg. is not so critical as in the case of low carbon steels. Similar remarks apply also to the case of high-speed tool steels, for which the range of forging temperature is very small.

In the case of carbon steels, as the elongation at ordinary temperature is greater than that at 200 deg. to 300 deg., a process of slowly stretching or bending a sample at room temperature rather than at 200 deg. to 300 deg. is a safeguard against fracturing.

Dr. W. H. Hatfield said that a somewhat similar investigation had been carried out in England with the same object, which was to obtain some information as to the manner in which steels were deformed during manufacture. The paper referred particularly to elongation and put forward the view that the forgeability could be measured by the elongation of the metal at high temperature. Had more data been brought forward by the author it might have led to an interesting discussion on the question of forging temperatures, but it did not appear to him that measurements of elongation could be accepted as an indication of forging qualities.

A paper on the "Indentation Hardness of Metals" of which he and Mr.[s] K. Takahasi are joint authors, was then presented by Professor Honda.

INDENTATION HARDNESS.

(1) In the usual method of measuring the Brinell hardness, the impression is measured after the load is removed; but in the case of hard metals, and especially of quenched steels, the recovery of the impression after unloading is considerable, so that the hardness thus obtained is very ambiguous.

(2) The Brinell hardness, when the impression is measured during the application of the load, is quite correct, and much less than that by the usual method of measurement.

(3) As the definition of hardness, the present authors adopt that proposed by Wüst and Bardenheuer; that is, the hardness is measured by the work required to produce the unit volume of impression.

(4) This hardness depends on two constants, k and a, characteristic of the substance; k depends on the elastic deformation, and a is the constant depending on the permanent deformation beyond the elastic limit.

(5) In the new definition of hardness, the initial hardness is given by—

$$H_0 = \frac{k}{\pi D}$$

D being the diameter of the ball. The hardness for a given load is—

$$H = \frac{k\,(3 + 2\,a\,h)}{\pi\,(3\,D - 2\,h)}$$

This obviously increases with the load.

Mr. Beardshaw said that, speaking from his experience as a practical steel maker accustomed to the Brinell machine, he was able to state that he had always found the Brinell test satisfactory for ordinary purposes.

Dr. W. H. Hatfield confirmed the view that the Brinell test gave definite and reliable results in industry, and he deprecated any suggestion that it should be given up in favour of another method. The paper was interesting from the scientific point of view, but it was too early to talk of applying the results described by the authors in the industrial world.

Sir William Ellis pointed out that it took a certain time to get a standard test adopted in the steel industry. The Brinell test was now very generally employed, and the introduction of other methods which would tend to disturb the present system was not desired at the present time.

Dr. W. Rosenhain agreed with those who had suggested an attitude of caution in disturbing the Brinell test, but it was also necessary to be cautious in adhering to it. The Brinell test had proved useful, but it was an empirical method which did not test any definite property of the material. It was extremely useful and better than nothing, but for very hard steels it was not altogether satisfactory. He did not suggest that the authors had gone far enough with their work to justify a change of practice, but he would ask the meeting to bear in mind that the Brinell test was only a rough approximation, and there were possibilities of obtaining measurements of hardness which had a real significance and would tell things which could not be deduced from the Brinell test. The value of the paper was that it called attention to one difficulty connected with the Brinell method and showed how it could be taken into account.

Mr. N. D. Chopra said that in outlying parts of India, where it was not possible to use other methods, the Brinell test had been used, but experience had shown that there was great variation in the results obtained, and that different figures were obtained from the same material in the morning and at night. As long as it was recognised that there were these disadvantages attaching to the use of the Brinell machine no great harm would be done, but in any event it was not possible in ordinary commercial work to introduce refinements of the kind suggested in the paper.

Dr. F. C. Thompson said that it might be possible to modify the Brinell test and obtain more satisfactory results than by the present methods. It must not be inferred that experiments on the Brinell method were intended to bring about its displacement, but rather to enable more accurate determinations to be made.

At this point, on the suggestion of the President, it was decided to introduce the paper by Mr. A. L. Norbury and Mr. T. Samuel on "Experiments on the Brinell Tensile Relationship."

THE BRINELL-TENSILE RELATIONSHIP.

The relationship between Brinell hardness numbers and ultimate stresses is well known and widely used in the case of steels. It has, however, its limitations, since different conversion factors have to be used, according to the composition, heat treatment, and ultimate strength of the steel in question. Moreover, when applied to certain materials, it breaks down altogether. The present research was undertaken with the idea of measuring the Brinell hardness of various materials—each under several different loads—and plotting the results so obtained according to Meyer's formula, $L = a \cdot d^n$. It was thought that the values of the constants a and n obtained in this way would, when compared with the tensile properties of the same materials, probably throw some light on those cases which did not fall into line with the general Brinell-tensile relationship. The results obtained are, however, almost negative in this respect.

Colonel Belaiew took the view that it was of very little importance whether the Brinell test did or did not give a definite physical constant. What was important was that, in spite of the criticisms which had been heard, the Brinell test did give a measurement of one and the same thing whenever it was used and had proved very useful from the practical point of view. It could not be denied that this method had emerged successfully from the test of workshop use. The mistake which was sometimes made was to ask from the Brinell machine results which it was never intended to give. When he was working on the homogeneity of steels some years ago he employed the Brinell method with excellent results when testing high carbon steels, and his own view was that when properly applied the Brinell method had a scientific as well as a practical value. The point made in the paper by Mr. Norbury and Mr. Samuel as to the relation between hardness numbers and ultimate stresses was very interesting.

An interesting discussion followed the presentation of the paper by Mr. Gerald S. Bell and Mr. C. H. Adamson on "Transverse Test Bars and Engineering Formulæ."

TRANSVERSE TEST BARS.

It has been said in regard to the testing of cast iron that nothing is certain but uncertainty, and, whatever truth may lie in this statement, it is a recognised fact that in testing transverse test bars, widely different results may be obtained from bars of the same chemical composition. This can be observed in the daily routine of the foundry, and varying results of tests have also been shown in the work of Turner, Hatfield, Levy, Coe, and others, even though their melting was done in crucibles. The same varying results are shown in the work of Johnson, Adamson, Hailstone, Smalley, Young, and others, their experiments being carried out under actual foundry conditions. From none of these, and other publications, can regular results, based on chemical composition only, be established. Such discrepancies decided the authors on an investigation based upon casting sets of transverse test bars of different sizes, but of the same chemical composition, and under casting conditions as identical as possible. Further, it was decided that these tests should be duplicated by sets of bars cast $^1/_{16}$in. oversize and machined down to dead size.

From this investigation, it would appear that the generally accepted engineering formulæ for the conversion of the transverse test on one sized bar to that on another sized bar do not hold when applied to cast iron test bars of different sizes.

The analyses of each set of the authors' test bars are shown to be almost identical, while all the casting temperatures are sufficiently near to each other to be taken as the same for all practical purposes.

It would therefore appear that something more than chemical composition must be looked for in order to account for the large difference between actual and theoretical results. Adamson has shown that test bars from the same ladle of metal, when cast into different sizes and calculated on engineering formulæ to 1in. by 1in. by 12in. centres, gives a much higher result per square inch on the smaller bar. He also shows a difference in Brinell hardness—the test being taken at the centre of a cross section of each bar—between 175 on the larger and 201 on the smaller bar, due entirely to the closeness of the structure.

A study of the fractures and also of the micro-sections of the bars tested by the present authors leads them to a similar conclusion—namely, that while structure has a great influence on mechanical tests, the engineering formulæ, some of which date back to the early part of last century, do not take this into account.

The comparative regularity of the difference between theoretical and actual results, however, incline the authors to the belief that, working with the above formulæ and the 1in. square bar as a standard, a correction factor, the value of which is somewhere in the vicinity of 2¼ cwt., should be added to the results obtained from the engineering formulæ in order to obtain what would have been the actual tests of the bar cast at the same time and under the same conditions. The results from which this conclusion is drawn, however, are hardly numerous enough as yet to lay down any definite factor.

Dr. L. Aitchison said he was not very much surprised at the results the authors had obtained, as it seemed to him that they were using formulæ which were originally intended to apply to metals which were stressed only up to their elastic limit, for stresses which were considerably greater than the elastic limit, in fact which were the breaking strengths. If the bars were of very considerable difference in section, as apparently those of the authors had been, the formulæ were not likely to apply unless the neutral axis was distributed in the different size bars in similar positions. Another thing was that, despite the experience of the authors, there was one set of conditions under which formulæ which were somewhat similar to those used had been found to be very variable, namely, in the testing of piston rings, which in the past, he thought, were tested on the breaking strength or the tensile strength of a separately cast test piece or a test piece which was merely an extension of the cylinder cast for the rings. That practice was now being abandoned in favour of testing an actual ring which was cut out from the piston ring pot, and a formula which was naturally related to those the author had mentioned in the paper did give very consistent results on the sizes of pots which were used for that class of work.

Mr. E. Adamson regarded the paper as an extremely practical one. The research had been carried out to his own knowledge in a foundry under ordinary working conditions, and therefore was valuable from that point of view. Years ago, from the irregular results he was constantly getting, he came to the conclusion that chemical analysis played only a very small part in the tests of cast iron. From his own researches, which were recorded in the *Journals* of the Institute, he came to the conclusion that the physical characteristics of cast iron as disclosed in the fracture played a prominent part, the most prominent part indeed, and that analysis played a secondary part. That statement he had made in that room on more than one occasion, and he thought the paper confirmed it. The value of the paper, he believed, had been already proved in the engineering world by the approval of inspectors.

The President said he personally had listened to the paper with very great interest. It was forty-five years ago since he built a testing machine for making transverse tests of cast iron. The machine was, if not the first, one of the first testing machines ever built for foundry work pure and simple.

Mr. G. S. Bell, in reply, said that it was a fact that inspectors had, even at that stage of the work, seen fit to pass a bar that had broken under the specified limit and to pass it as a result of the figures of the research being laid before them. The tests which the authors had carried out and intended to carry out would be of no importance unless they could find direct application in ordinary every-day foundry routine.

A paper on "The Hardening of Silico-Manganese Steels," by Mr. E. W. Colbeck and Dr. D. Hanson, elicited a short discussion.

SILICO-MANGANESE STEELS.

The experiments described in this paper show that the temperatures required for complete hardening of the steels used are very much higher than the corresponding hardening temperatures for straight carbon steels having the same carbon content. The work described in the present paper emphasises the fact that for complete hardening of low carbon silico-manganese steels a much higher temperature is required. The mechanical tests described indicate that the use of a high quenching temperature would produce a material with a higher tensile strength and hardness. The low carbon steel is probably only unsuitable for springs if a low quenching temperature is used. With a higher quenching temperature, the material possesses a high tensile strength, which may reach 100 tons per square inch, with considerable ductility, as indicated by the reduction of area in a tensile fracture.

There are certain obvious disadvantages in the use of a temperature of 1100 deg. Cent. for hardening steel. Such troubles as distortion, cracks, overheating, and decarburisation are frequently experienced when such a high temperature is used in practice. It is, however, interesting to note that the authors' specimens of the low carbon steel did not crack even after water quenching from 1100 deg. Cent., that they did not become overheated on heating for short periods, up to half an hour, at this temperature, and that they were but slightly decarburised.

The authors do not suggest, as the result of the few experiments here described, that the use of low carbon silico-manganese steel, hardened from 1100 deg. Cent., is desirable in practice, but their results do show that this material, so treated, possesses great strength and hardness, and could be used, after suitable tempering, for such articles as springs. The results indicate, however, that the full strength and hardness of low carbon material can only be developed by the use of a high quenching temperature, and that the A3 point of the steel varies greatly with small variations in the carbon content. The use of material possessing a higher carbon content—0.5 to 0.6 per cent.—for which a lower quenching temperature is required, is probably more satisfactory, and this practice is now standard in many spring shops.

Dr. J. H. Andrew said that the most commendable feature of the paper was that it gave results which were of great use in practice, and there was a total absence of any imaginative theory.

Dr. Rosenhain said the paper did not claim to clear up the whole question of that group of steels, but it did throw some light on their behaviour on hardening, which was not only a matter of practical importance, but indicated a very clear need for the full investigation of those alloys from the scientific point of view. He believed that when that investigation was made results of very great practical interest were likely to flow from it.

Mr. Dartrey Lewis referred to work which had been recently done in the Research Department at Woolwich. That work had not been carried out in connection with manganese steels, but in connection with stainless steels containing 12 to 14 per cent. of chromium to which silicon had been added, and the effect of the silicon upon stainless steels followed on exactly the same lines as the effect of silicon upon manganese steels.

Mr. W. T. Griffiths said that the authors had done useful work, but the investigation required to be carried another stage, particularly in connection with the influence of silicon, which seemed to be quite different from that of chromium.

Dr. Aitchison said there seemed to be a considerable lack of accurate information as to the relationship between mechanical properties and heat treatment in those steels which were generally used for laminated springs. The work of the authors would be of very great assistance to the steel spring industry. It was possible to appreciate very readily the need

for investigation when one examined the types of failures that occurred with leaf springs. There was always the difficulty of deciding whether a spring had failed through lack of ductility or lack of strength, and he did not think it was possible to diagnose such things until the heat treatment of materials had been thoroughly worked out and the relation between heat treatment and mechanical properties fixed. The work of the authors would assist very materially in that direction.

A paper was presented by Mr. D. J. Macnaughton on "The Hardness of Electro-deposited Iron, Nickel, Cobalt, and Copper." The author's summary is given below.

HARDNESS OF ELECTRO-DEPOSITED IRON, NICKEL, COBALT AND COPPER.

(1) The Brinell hardness numbers of the deposits obtained under the conditions described range between the following limits:—Copper, 58–66; iron, 140–360; nickel, 180–420; cobalt, 270–311.

(2) The conditions of deposition which within certain limits have been found to cause increase in hardness are:—(*a*) Decrease in temperature (iron deposits); (*b*) increase in current density (copper deposits and iron deposits); (*c*) decrease in metal ion concentration (nickel deposits); (*d*) increase in hydrogen ion concentration (iron deposits, nickel deposits).

(3) Of these conditions, the first three coincide with the factors which, according to Bancroft, cause decrease in the crystal size of deposits; and the fourth (*d*) has been noted by various investigators, such as Hughes (iron deposits) and Thompson (nickel deposits), to favour small crystal size.

(4) By the judicious adjustment of the various factors referred to above, the hardness of deposits of iron, nickel and cobalt can be controlled within fairly close limits.

(5) Several possible alternative explanations of the high hardness of certain deposits have been discussed. These respectively ascribed the hardness to—

(*a*) Hydrogen deposited simultaneously with the metal, forming a hard solid solution with it. The amount of hydrogen retained in solid solution seems insufficient to account for the high hardness attainable.

(*b*) Deposition of the metal largely in the amorphous condition. This is thought to be improbable.

(*c*) Displacement of atoms from their normal positions on a crystal lattice by electrical forces acting on them while they are being deposited, resulting in distortion of the crystal lattice growing, with consequent deformation, partly permanent and partly elastic, thereby producing an effect similar to that of cold work. It does not, however, appear likely that the forces of crystallisation can be affected by the electrical forces involved during deposition.

(*d*) The minute size of the crystals of the deposited metal. The deposition of hydrogen with the metal may be one of the factors interfering with crystal growth, and thus reducing the size of the crystals.

Sir Robert Hadfield said the paper was of particular interest to him because during the war he, with many others, had to contemplate the very serious position of not being able to get driving bands of copper, and our enemies took up the matter of deposited electrolytic iron in order to use such material for driving bands. He believed quite a large number of projectiles were fired with those bands, and in that respect there was a certain economy effected in copper. But speaking from the point of view of the much more peaceful times of the present day, the question of the production of electrolytic iron at a reasonable price was of very great importance. He was informed that electrolytic iron, perfectly pure iron, could be obtained from a French firm for a very moderate figure, seeing that it was quite as pure as the purest Swedish—something like £12 per ton. That seemed a very remarkable accomplishment. He believed the firm was still making considerable quantities of electrolytic iron. Experiments he had carried out did not confirm a statement by Mr. Pilling that annealing electrolytic iron by heating between 300 deg. and 400 deg. Cent. hardened it, but they did confirm the view that that treatment removed initial brittleness. There might be a very useful field for the application of electrolytic iron if it could be produced at a sufficiently low cost.

Mr. E. T. Ollard said that there were American firms who had produced electrolytic iron on a commercial scale with a view to obtaining iron of high magnetic qualities. Electrolytic iron was very nearly pure, and would be a commercial proposition for that reason. Nickel, which he had been chiefly interested in, was used for two main purposes, one for protection from corrosion and the other for building up parts to size when they had been wrongly machined or worn out from any cause.

Mr. S. Field said the subject of electrically deposited metals was becoming of considerable importance to many industries. The engineering applications had been particularly mentioned, but there was also the application of the deposition of such hard metals in the printing trade. The deposition of iron upon engraved copper plates, and the nickel facing of stereotyped plates, which distinctly lengthened their life, was of importance. Some million impressions could be taken as against tens of thousands from the ordinary printing plate. It would be for the author to emphasise to those who were practically engaged in the work the necessity for a very careful control in all the conditions of that process of deposition. One result was very striking, namely, the harder deposits obtained from the dilute double nickel salts as compared with those obtained from the single nickel salts.

A paper entitled "Notes on the Testing of Metal Strip," of which the authors were Dr. Leslie Aitchison and Mr. Leslie William Johnson, was then read.

The New Orient Liner Orama.

In our issue of May 2nd we were able to announce that the Orient Steam Navigation Company had placed an order for another large liner of some 20,000 tons register with Vickers Limited. This new ship, which will be delivered within eighteen months, is the last order in a building programme comprising three 20,000-ton steamers, which, together with the company's Ormonde, a liner of 15,000 tons, will eventually take up the monthly sailings of the Orient Line fast mail service to and from Australia. The first ship of the series to be laid down was the Orama at Messrs. Vickers' Barrow yard, and the second the Oronsay at the yard of John Brown and Co., Limited, Clydebank. On Tuesday last, the 20th inst., the Orama was launched at Barrow, and it may be of interest to our readers to give some account of a type of ocean-going liner which, together with her sister ships, will be notable in the annals of 1924–5 merchant shipbuilding. The Orama is, moreover, important on account of her being the first large passenger ship which the firm of Vickers Limited has constructed since the end of the war period of naval construction. The longitudinal diagram reproduced above gives a general idea of the accommodation and machinery spaces, while the engravings given in the Supplement show typical views of one set of main propelling machinery. The leading dimensions and particulars of the Orama are as follows:—

Hull Particulars.

Overall length	658ft.
Breadth	75ft.
Depth	63ft.
Gross tonnage	20,000 tons
No. of passengers carried	600 first-class 1200 third-class

Machinery Particulars.

Type, single reduction geared turbines, Parsons impulse and reaction type	
Total shaft horse-power	20,000 S.H.P.
Astern power, about	70 per cent. of ahead
Working steam pressure	215 lb. per sq. inch
Degree of superheat	150 deg. Fah.

PASSENGER ACCOMMODATION.

In designing these new ships, the owners and builders have kept before them the special requirements of the Australian mail service, and advantage has been taken of the latest practice in cabin arrangement, whereby every saloon cabin is provided with either a window or a port-hole. Most of the first-class cabin space, which is sufficient for 600 passengers, is grouped on C, D and E decks, while third-class accommodation for some 1200 persons is also provided. A feature of the first-class cabins is the large number with single berths, approximately one-third of the passengers carried being accommodated in cabins of this type. In addition, thirteen special state rooms, with combined bathrooms, are provided, and also one suite of rooms comprising a sitting-room with two bedrooms and a bathroom.

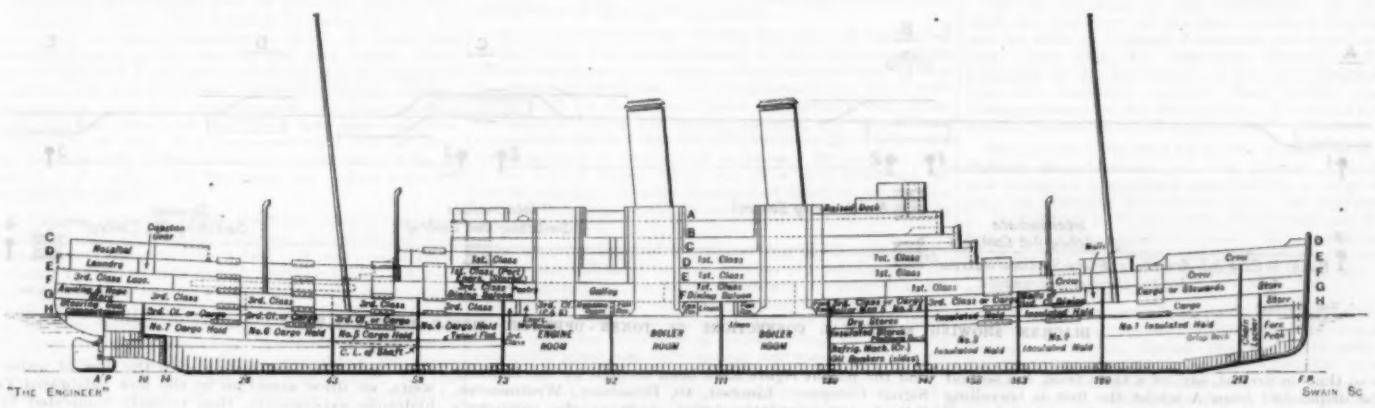
The public rooms are large and will be furnished in a very pleasing and comfortable manner. On B deck there are the lounge, smoke-room and *café*, while the drawing-room is placed at the fore end of the bridge on C deck. Amidships on F deck is the first-class dining saloon. This room, which is 10ft. in height, will be furnished with small tables, giving seating accommodation for over 300 passengers. On the same deck further aft is the third-class dining-room, which will be furnished in panelled oak and will provide accommodation for approximately 500 people. Abaft the room last mentioned is one of the third-class promenade decks, on which the third-class smoke-room and lounge are arranged. A feature of the ship is the spacious promenade deck accommodation for both classes of passengers.

The lifeboat equipment is noteworthy on account of the adoption of the Maclachlan boat-lowering gear, which permits of boats being launched in the shortest time by a single officer. Boats sufficient for the full complement of passengers and crew are carried, and include two motor boats.

As will be seen from the drawing above, the vessel has been subdivided in such a manner as to meet the requirements of the Board of Trade and the International Convention. Another interesting feature of construction is the adoption of the duct keel, which greatly facilitates a convenient pipe arrangement, and gives access to all joints. The cargo-handling gear will include electric winches serving each hatch, this type of winch gear having been chosen on account of its silent working.

THE PROPELLING MACHINERY.

The vessel will be propelled by twin screws driven by two sets of steam turbines geared to the propellers through single reduction gearing. In the Supplement accompanying to-day's issue we reproduce views of one of the geared turbine units in course of erection, and also in its completed state, ready for placing in the ship. The turbines are of the Parsons impulse and reaction type, each set comprising, as shown, one high-pressure, one intermediate-pressure, and one low-pressure turbine, working in series, and each driving separate pinions, which engage with a common main gear wheel. With a turbine speed of 1370 revolutions per minute, the propeller speed will be about 95 revolutions per minute, the two sets of machinery being designed to develop about 20,000 shaft horse-power. The total astern power will be about 70 per cent. of the full power ahead. We note that two rows of velocity compounded blading are used in the high-pressure turbine, the intermediate and low-pressure turbines being of the pure reaction type. Astern turbines are built into the main intermediate-pressure and low-pressure casings, and in the astern turbines combined velocity compounded and reaction blading is used. Double helical gearing is employed, and the turbines are joined to the pinions by flexible couplings. The main thrust blocks are of the Michell type, and electrical turning gear is provided. Auxiliary machinery includes three 400-kilowatt 220-volt turbo-generators, by W. H. Allen, Sons & Co. Ltd., which firm has supplied the emergency lighting set consisting of a two-cylinder hot-bulb engine coupled to a 36-kilowatt generator, placed on the boat deck. Steam is raised in six double-ended and four single-ended boilers of the ordinary multitubular return-tube type, which are arranged in two boiler-rooms. These boilers are 16ft. 6in. mean diameter, and the length of the double-ended boiler is 22ft. and that of the single-ended 11ft. 3in. They are arranged for oil burning with forced draught, on the Howden-Wallsend system, and smoke-tube superheaters are fitted, which are designed to raise the steam at the turbine stop valve to a temperature of 150 deg. Fah. above saturation temperature. At a later date we hope to publish a complete detailed description of the machinery arrangement of one of these three notable vessels which the Orient Line is adding to its fleet during the next eighteen months.



ORIENT LINER ORAMA

The Working of Single Lines of Railway.

WITH few exceptions single line railways in all countries of the world are controlled by an electrically-operated token system, and for that purpose are divided into sections which vary in length according, mainly, to the amount of traffic, but in part to the number of stations or junctions and the distances between them.

A general essential of all single lines is that there must be places where trains in one direction may pass trains in the reverse direction, and where the less important trains may be passed by others going in the same direction. It is not necessary to provide all stations with these facilities nor is it essential that the places having such facilities, should be stations. All stations or places provided with these arrangements, however, must mark the end of one token section and the beginning of the next. It is clear that a train must not enter a section if another is traversing the section in the opposite direction. It is also obvious that if absolute block working is in operation a second train must not enter a section until the first has arrived at the other end of that section, which latter usually is at a crossing place.

Occasionally a station or place that is not provided with crossing facilities is used as the end of one section and the beginning of another, for the expedition only of trains following each other. Such stations are known as non-crossing stations, and the token system is so arranged as only to permit following trains to be between the passing places on either side of such a station at the one time. An instance in which such a facility is beneficial is where a station is at the summit of an incline and the distance between the passing places on either side is about the normal length of the sections on the line. If no provision were made at the summit a train would take longer to travel from the two passing places on either side of the summit owing to the heavier pull up the incline. Hence the provision of non-crossing arrangements at the summit is a distinct advantage for following trains.

With this explanation let us imagine a single line from A to E, as shown in the accompanying sketch, on which there are three intermediate stations B, C and D. B is a non-crossing place but is provided with token instruments so that on arrival, say, of a train from A a second may be dispatched from A whilst the first is travelling from B to C, and, *vice versâ*, a train dispatched from C whilst one is travelling from B to A. C is a crossing place, but D is neither a crossing place nor a non-crossing place. The token sections thus are A—B, B—C, C—E.

It is quite a simple matter to arrange on a double line of railway for a signal-box, say Y, to be closed at times when adjoining cabins X and Z are open. The operator at Y, before going off duty, cuts out his block instruments by, say, turning a switch, and joins the block wires, so that X and Z communicate with each other instead of with Y. This, however, cannot be done on single line railways operated on the token system, as the token for X—Y has no authority in the Y—Z section. Similarly a token, say, for the A—B section, illustrated in the sketch, only gives authority to travel between these points. Consequently the switching-out, as applicable to double line railways, cannot be applied to allow B or C or both of them to be closed at times when A and E are required to remain open.

There has, however, recently been installed on the Bedford–Sandy section of the London, Midland and Scottish Railway an arrangement which permits any number of sections to be switched out. Thus, in the accompanying illustrations, B and C may be closed at times, and A—E become one long section with long section instruments 4, 4 at A and E. This system provides for the greatest flexibility, consistent with safe operation, and can be applied to non-crossing stations and also to crossing stations or both, as will be ascertained by the following explanation.

When ordinary sectional working is in operation a token out of the A—E instruments is secured in a terminal switching-out control at E, thus placing the instruments 4, 4 out of service for token purposes. When it is desired to close B and C, the operator at B obtains an A—B token from his instrument 1 in the usual manner. This token is placed in the intermediate switching-out control at his station. C obtains a B—C token from his instrument 2, which is placed in his intermediate switching-out control, and E obtains a C—E token from his instrument 3, and places it in the terminal switching-out control. This action on the part of B, C and E, joins up the line wire of the through instruments 4, 4, and if any one of the three omits to place the token as described, the line wire referred to remains disconnected at that place until the operation is performed. It will also be gathered that the withdrawal of these tokens places the sectional instruments 1, 1, 2, 2, 3, 3, out of service for token purposes. Moreover, the placing of the sectional staffs in the controls at B, C and E causes them to be self-locked in the controls.

To obtain the A—E token from the terminal switching-out control at E current must be obtained from instrument 4 at A, which cannot pass along the line wire if it remains disconnected at B or C. Therefore, the flowing of current along the through section line wire to release a through section token is a guarantee that the sectional instruments are out of service, and that no sectional staffs can be in use for traffic purposes. When E obtains the A—E token from the terminal control and inserts it in his instrument 4 long section working may be established.

When it is desired to re-open B and C the operator at E obtains an A—E token from his instrument 4 and places it in the terminal switching-out control, where it is self-locked. This action releases the sectional token C—E from this control, and when E places it in his instrument 3 C can abstract a token for section C—E from his instrument 3. The latter man uses this C—E token to unlock the B—C token held in his intermediate control which, when accomplished, he places in his instrument 2 and also returns the C—E token to his instrument 3. B performs similar functions to C, thus bringing into use instrument 1 in his box. This brings into service instruments 1, 1, 2, 2, 3, 3, and places instruments 4, 4, out of use.

The intermediate switching-out controls are provided with means for connecting up with the interlocking arrangements where such exist, so that no point movement or other conflicting operation may take place should any attempt be made to disturb the levers whilst the station is unattended. As illustrated, C is a crossing place, and in this country the practice is for trains from A to E to pass along the upper loop and those from E to A along the lower. When, however, C is closed, one or other loop must be selected for use in both directions. The interlocking is controlled according to whether the station is closed for token purposes or otherwise.

Assuming, further, that it is desired to detach or collect vehicles at B or C during the closed period, facilities can be provided that will permit the necessary point operation by using the through token A—E for this purpose. The token would be locked up during the process and consequently the train could not proceed on its journey until the points were restored to the position representing the closed condition of the station. At D the siding would be worked by a lever, and arrangements can be made to release this lever by either a C—E or an A—E token.

This arrangement can be applied to any token system, and the patent rights have been secured by the Railway Signal Company, Limited, 40, Broadway, Westminster, S.W. 1, the apparatus being made at the company's works at Fazakerley, Liverpool.

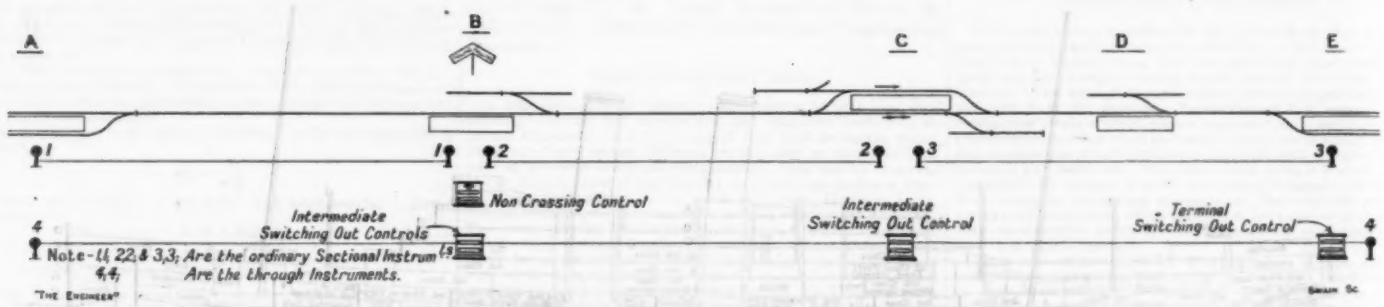


DIAGRAM SHOWING ELECTRICAL CONNECTIONS OF TOKEN-OPERATED SINGLE LINE RAILWAY

REPORT ON ATMOSPHERIC POLLUTION.

THE ninth report of the Advisory Committee for the Investigation of Atmospheric Pollution, which covers the year ended March 31st, 1923, has just been published.

After a short introductory section and summary, the year's operations are described under six sections. The first discusses the results obtained by what is known as the standard deposit gauge, in which atmospheric impurity accumulates month by month with the rain. Thirty-five such gauges were in operation during the year. It is shown that there is a distinct improvement in the purity of the air during the year as compared with the average of preceding years. A table is given showing the places with the highest and lowest deposits for the year. The highest total deposit is shown in Rochdale and the lowest in Rothamsted. The greatest amount of tar was deposited in Newcastle-on-Tyne, while the highest deposit of sulphates was found in Southwark Park, London.

The second section deals with a new form of stoneware gauge introduced by the Committee as an improvement upon the original form, which has now been tried for more than five years.

The third section is concerned with the results obtained with what is known as the automatic filter, an instrument which measures hour by hour throughout the day and night the amount of impurity suspended in the air. The measure is in this sense distinct from that of the impurity which collects in an open gauge. The curves of the suspended impurity derived from the instrument show in all places a maximum in the forenoon. The distribution over the twenty-four hours is very suggestive. There is a curious tendency in London in the direction of a reduction in suspended impurity towards the end of each week.

In the fourth section is described investigations made with an instrument called the jet dust counter, which secures the microscopic examination of dust particles and their number, irrespective of their colour or nature. The use of this instrument has extended rapidly both in England and in foreign countries. Its high efficiency and convenience of operation make it of great value in the examination of all problems connected with air-borne dust. Some curiously interesting results have been obtained with this instrument, as, for example, the discovery of spherical glassy particles in the air, the sudden appearance of large numbers of mould cells in the air during the autumn—traced to falling leaves—and the occasional presence of crystals of soluble salts in the air.

The fifth section is devoted to a description of researches on the visibility of distant objects, as affected by atmospheric pollution; the methods developed and results obtained are described.

In the sixth section we are told that research in the field of atmospheric pollution covers problems of great importance from the points of view of health, economy, preservation of buildings, visibility, formation and prevention of fogs and other matters having a bearing on the public weal.

SIXTY YEARS AGO.

THE preservation from rusting of cast iron in bridges formed the subject of two short paragraphs in our issue of May 20th, 1864. In one we read that the castings for the two bridges across the Severn, then recently completed by Mr. (Sir) John Fowler, had been treated by exposing them at a high heat to contact with hematite ore in the absence of air. A much more elaborate process, known as the induration of iron, was being applied to the ironwork of Blackfriars Bridge, then in the course of construction. This process, the patent rights for which were held by Morewood and Co., involved heating the cleaned iron in a special type of furnace, and when it had acquired the requisite temperature, plunging it into a bath of molten prussiate of potash and chloride of potassium. The iron was then dipped in boiling water containing a certain proportion of potassium cyanide, and was subsequently washed and dried. Thereafter it was coated twice with an asphaltum paint, and when fixed was given two further coats of the same substance. The contractors were allowed £4 per ton for carrying out the process, indicating a total cost of £16,000 for the induration and painting. It was added that about 40 tons of iron oxide had recently been removed from the Menai Bridge in the process of cleaning, and the question was asked whether in the case of the Blackfriars Bridge the £16,000 would not have been better expended in strengthening it by the use of extra material without indurating it anywhere. By so applying the sum, it was estimated that the strength of the bridge would have been increased by about 50 per cent. . . .

In a leading article dealing with the flow of water over weirs, we drew attention to the now celebrated Lowell hydraulic experiments, then recently completed by Mr. Francis in America, and expressed the view that this important investigation was not sufficiently known in this country. We referred to his "beautiful arrangements for the determination of water levels to the ten-thousandth of a foot by the hook gauge, and his complete organisation of a staff of observers in telegraphic communication with the person appointed to record the results." His deductions, we held, were worthy of more confidence than those of any other hydraulic authority of the time. . . . In our opening pages we reviewed a book by Mr. D. K. Clark dealing with the machinery exhibited at the International Exhibition of 1862. We were not pleased with Mr. Clark, primarily because he had, so we alleged, taken to himself the whole or the major portion of the credit for the percussive theory of boiler explosions, a theory which Mr. Zerah Colburn claimed as his own. We followed our review with a letter from Colburn to Clark and letters to Colburn from Mr. A. L. Holley and Mr. James Dredge, all in support of our then editor's claim to the parentage of the percussive theory.

Obituary.

SAMUEL SPENCER.

WE have to record with regret the death of Mr. Samuel Spencer, which took place from pneumonia, on Friday, May 16th.

Mr. Spencer, who was in his eighty-seventh year, was born at West Bromwich, and began his business career with the Horseley Company, Tipton, with which he was connected for twenty-six years, during which period he was concerned in the erection of hundreds of gasholders all over England, as well as roofs and bridges. In 1878 he joined the firm of J. E. and S. Spencer, and besides being chairman of that firm, he acted in the same capacity for the Colonial Gas Association, the Ascot Gas Company, and the Egham and Staines Electricity Company, and was a director of John Spencer, Limited, tube manufacturers, of Wednesbury, and the Croydon Gas Company. Only shortly before his death he resigned the chairmanship of the Woking Gas Company. He was an associate member of the Institution of Civil Engineers.

THE Ballina, New South Wales, Municipal Council has decided to use wood pipes for an 8in. water main, as calculations show a money saving with them assuming their life as fifteen years, and that of cast iron pipes as fifty years.

Railway Matters.

AT Camden Town Junction, London Electric Railways, described in THE ENGINEER of March 14th, 1504 trains are dealt with daily. During the rush hours there are 96 trains in an hour, or an average of one train for every 37 seconds.

IN answer to a question on the 12th inst., it was stated that twenty of the locomotives built at Woolwich had recently been sold, and as thirty were still to be sold it would not be in the public interest to disclose the sale price. The cost of construction of the locomotives was £15,600 each. The twenty locomotives already sold were purchased by the London and North-Eastern Railway Company.

THE two surviving vessels—the Ulster and Munster—of the fine fleet of four mail steamers of the City of Dublin Steam Packet Company, have been sold at a break-up price. It had been hoped to sell them for use in Canada, but their age was against their conversion from coal to oil-burning. It will be remembered that they were engaged in the Holyhead and Kingstown mail services, and that the contract for the conveyance of the mails passed to the London and North-Western Railway in November, 1920.

THE railway statistics for the month of February last, just published as a stationery Office publication, show an increase in the passenger receipts of 1.6 per cent., even although the number of passenger journeys fell off 1.9 per cent. Despite the decrease in the number of passengers there was an increase of 8.1 per cent. in the passenger train mileage, owing no doubt to the intensified competition which has resulted from grouping. This fact has probably now been appreciated by the companies, and is the main cause for fewer "May alterations" than usual.

THE freight traffic statistics of the Ministry of Transport for the month of February, 1924, show an increase over the corresponding month of 1923 of 8.7 per cent. in the tonnage. It is suggested that this fall may have been contributed to by delayed traffic that should have been dealt with during the enginemen's strike which ended on January 29th. The ton-miles as a consequence, combined with the average length of haul being increased from 52.2 to 54.7 miles, were 14 per cent. higher than in February, 1923. The increase in receipts—1.1 per cent.—was not proportionately as great, as there were reductions made in the rates in May and August, 1923. The increase of 8.7 per cent. in tonnage was accompanied by an increase of 10.9 per cent. in the freight train mileage. The average train load was, however, the best recorded during the four years that the figures have been compiled. It was 138.68 tons, and compared with 135.09 tons. The average train miles per engine hour were 3.36, as against 3.17, and so the ton-miles per engine hour fell from 453⅞ to 439¼.

IT was nine years yesterday, the 22nd, since the accident at Quintinshill, Caledonian Railway, in which 224 passengers and 3 servants were killed. It was one of those accidents for which little excuse could be found. A local train from Carlisle had to be shunted for one of the night Scotch expresses to pass. It was crossed on to the up line, and its presence there was subsequently forgotten, and an up troop train was accepted and all signals lowered for it. The consequent collision obstructed the down main line, and the wreckage was swept ahead by the Scotch express, which arrived immediately afterwards. The crowning horror was the fire in the *débris* caused by the live coal from the four engines concerned. Six of the passengers and one of the servants killed were in the express. A factor that contributed to the serious extent of the disaster was that out of fifteen Great Central coaches conveying the passengers in the troop train eleven were six-wheeled vehicles, many being old and all with oak underframes. This was the most serious accident ever experienced on British railways.

THE Ministry of Transport, like the Board of Trade before it, possesses considerable power over railway companies in connection with the provisions made for the safety of the travelling public when new railways are opened. The term "new railways" is very wide, as it applies to additional connections and alterations to existing connections, and to new stations, on lines already opened for passenger traffic. This power, however, at once ceases directly a line, or any work on a line, has been passed by the inspecting officer. This fact was acknowledged by the Minister of Transport on the 13th inst., when asked whether he had made representations to the London and North-Eastern Railway Company with respect to the entirely inadequate platforms at a great number of its stations, more especially on the line between Liverpool-street and Cambridge. Mr. Gosling, having made the above admission, said that he had brought the matter before the railway company, which had replied that in view of the expense involved, it did not feel justified in carrying out at present the improvements desired.

ACCORDING to the Board of Trade returns the value of the railway material exported during the first three months of the present year was as follows, the corresponding figures for 1923 and 1922 being added in brackets:—Locomotives, £583,917 (£839,474, £2,111,946); rails, £538,519 (£470,120, £1,009,336); carriages, £306,194 (£328,356, £470,992); wagons, £952,912 (£629,725, £1,480,961); wheels and axles, £200,610 (£243,353, £381,792); tires and axles, £183,171 (£104,191, £169,095); chairs and metal sleepers, £353,650 (£156,747, £645,221); miscellaneous permanent way, £354,605 (£265,882, £459,290); total permanent way, £1,693,737 (£1,311,781, £2,733,351). The weight of the rails exported was 60,530 tons (54,996 tons, 94,943 tons), and of the chairs and metal sleepers, 27,009 tons (13,817 tons, 42,627 tons). During the month of March last locomotives to the value of £98,372 were shipped to India, of £19,400 to the Argentine, and of £7000 to other countries, than the Argentine, in South America. Rails of the values as follows were shipped during March to:—Argentine, £33,610; India, £20,655; Australia, £20,203; New Zealand, £13,708; and Chili, £8878.

Notes and Memoranda.

DURING last year the mining industry of South Africa consumed materials to the value of £15,585,188, of which over £6,000,000 worth was imported. The engineering materials imported amounted to some £3,640,000.

SOME interesting articles by Mr. James Strachan on "The Crystal Detector in Theory and Practice," are appearing in the *Wireless World*, the articles being based on a number of experiments the author has carried out with a view to establishing a theory concerning the operation of crystals and other contact detectors.

A NEW shipbuilding company has been founded at Barcelona, under the auspices of Krupps, of Essen, with the title "Naval Union of the Levant." The capital has been fully subscribed, and no shares are being offered to the public. If conditions allow, the new company will build warships and locomotives, as well as merchant vessels.

AN article in a recent issue of the *Contract Record*, of Canada, describes an equipment used in America for driving piles under water. A hammer type of driver was used and low-pressure steam admitted below the piston to exclude water. The scheme has the advantage that the piles need be very little longer than the amount necessary for penetration, neither need they be cut off with a submarine saw.

THE total production of electric power in Pennsylvania in 1923 reached 5,438,274,000 kilowatt-hours. The total production for California was 5,067,158,000 kilowatt-hours. Of these totals Pennsylvania produced 4,885,968,000 kilowatt-hours by fuel power and by water power 552,306,000. California in the same period produced by fuel power 966,512,000 kilowatt-hours, and by water power 4,100,646,000 kilowatt-hours.

INVESTIGATIONS carried on by the American Bureau of Standards have shown that when beryl is substituted for feldspar in the manufacture of porcelain in amounts varying from 25 to 45 per cent. of the total mixtures, the other components being silica and clays, a product is obtained which displays a very high electrical resistance and low thermal expansion. This porcelain is therefore considered a very promising material for electrical uses. Owing to the scarcity of beryl, there has been no commercial production of this type of porcelain.

IT is reported that Mr. Wilbur, Secretary of the United States Navy, has pledged himself to lend the co-operation of his Department in testing a Transatlantic mail service by means of dirigibles. It is understood that ZR 3, now being built for the United States in Germany, will arrive in America during the coming autumn, and Mr. Wilbur emphasises the fact that the dirigible mentioned is limited by agreement to commercial purposes. He declares that if the United States Navy can show that mails can be carried regularly between Europe and America in two days or less, Washington will be satisfied that the expenditure is fully justified.

IN a recent issue of *Ingeniören* Mr. H. Kronkvist describes the failure of the top portion of a reinforced concrete chimney at Limhamn, Sweden, and states that his firm has abandoned the construction of such chimneys and has reverted to brickwork. Another chimney, 164ft. high, used for discharging fumes from an ammonia extraction plant, was built in 1915 and was in a dangerous condition in 1923. The external and internal layers of concrete had separated from the reinforcement to a height of 59ft. above ground level, and there was much other damage. It is intended to replace this chimney with one constructed entirely of brickwork.

THE non-corrodible character of electrolytic iron is often spoken of. All electrolytic iron does, however, rust, according to Mr. D. Belcher, and more readily than is commonly imagined. In fairness it should be said that electrolytic iron is in general less attacked than ordinary iron and steel, but where resistance to corrosion is the important factor the engineer will go to copper, zinc, lead, chrome iron, &c. As a base material for alloys electrolytic iron demands attention because of its purity, but the important consideration is price, and it seems doubtful whether crude electrolytic iron can compete with the present forms of commercially pure iron.

AN illustration in the April issue of *Vulcan* shows the destructive effects caused by the breakdown of one of the 1500-horse-power motor generators at the power plant of the Toledo Railways and Light Company, at Toledo, Ohio. The machine, which was about 24ft. long by 10ft. in width and 9ft. in height, and weighed over 50 tons, suddenly and without a moment's warning burst in pieces. Not a single person was injured, although several men were working on the switchboard almost overhead. The damage to the plant, however, was enormous. The generator set itself was reduced literally to a heap of scrap. The cable connections were all broken, and the town was plunged in darkness for several hours. As the electrical machinery described was not insured, the whole of the loss, which was estimated at 50,000 dollars, will fall on the owners. From the evidence of eye-witnesses, it would seem that the motor, for some unexplained reason, began to race, and in a few seconds attained its bursting speed.

IN the course of a lecture at the Royal Geographical Society's rooms, Brisbane, Mr. B. Dunstan, the Chief Government Geologist of Queensland, said that in 1914 Queensland emptied out of the artesian basin by means of bores about 500,000,000 gallons of water per day, while in 1923, in nine years, the yield had decreased to about 300,000,000 gallons per day. This represented a diminution equal to 4.6 per cent. per annum, and notwithstanding that during these nine years 300 additional bores were sunk. If the yields were averaged with the number of bores, it would be found that the decrease was 6 per cent. per annum. The number of artesian and sub-artesian bores in Queensland was 2906, and in New South Wales 506, or about one-sixth of the number in Queensland. The total depth of bores in Queensland was 3,600,000ft., in New South Wales 800,000ft., or one-quarter the length in Queensland. The total daily flow in Queensland was about 300,000,000 gallons, while in New South Wales it was 85,000,000 gallons.

Miscellanea.

THE new 60,000-ton floating dock at Southampton is to be opened by the Prince of Wales on June 27th.

THE re-blading of the Mauretania's turbines has been completed and she is to be in readiness to sail on May 31st.

IT is reported that a seam of coal 3ft. 6in. thick has been discovered at Warragul, Victoria. It outcrops on a hillside.

THE output of coal in New South Wales last year amounted to 10,478,513 tons, valued at the pits mouth at £8,607,892.

THE Sydney municipal authorities are considering a water supply scheme which will involve the expenditure of £243,110.

A NEW wireless station has been put up at Tarawa, in the Gilbert Group of Pacific Islands, and is in communication with Ocean Island, 240 miles distant.

IT has been decided to apply for the permission of the Electricity Commissioners for the extension of the Burton-on-Trent supply to a large rural area on the Staffordshire and South Derbyshire side of the town.

THE output of sulphur in Japan during 1923 amounted to 35,125 tons, according to figures published by the Japanese Department for Agriculture and Commerce. This is an increase of 6.5 per cent. on the previous year.

IT is reported from Athens that the Greek Government has signed a contract with the Schneider Works for the construction of two submarines of 600 tons each. It is stated that the vessels will be ready within fifteen months and will cost 11,970,000 French francs.

GOOD progress is being made with the wireless station at Klipheuvel, South Africa, the estimated cost of which is £500,000. Four of the proposed 16 masts, each of them 830ft. high, are actually being erected now, and the whole station is expected to be completed early next year.

A SKETCH published by the *North Mail* shows a design prepared by Sir Maurice Fitzmaurice, Mr. Basil Mott, and Mr. W. J. Steele, for the proposed bridge across the Tyne. It is a single arch structure, with a suspended deck having a total width of 56ft. The head room at high tide will be 84ft.

ON the occasion of the celebrations in connection with the centenary of the birth of Lord Kelvin, which will be held at Glasgow University on Commemoration Day, June 25th, Dr. Alexander Russell, F.R.S., the president of the Institution of Electrical Engineers, will give the memorial oration. Lord Kelvin was three times president of the Institution of Electrical Engineers, and Dr. Russell is an old pupil of his.

RECOGNISING the need for it, the Federation of Leather Belting Manufacturers of the United Kingdom has now compiled a standard specification, a copy of which may be obtained on request from the secretary, Mr. L. D. Kidson, 1, Booth-street, Manchester, or from any firm of belting manufacturers. This specification is to be regarded as the minimum standard of quality that should be demanded by buyers and users who require a belt of reliable quality.

THE Canadian exports of gold, including gold-bearing quartz, dust, nuggets and bullion obtained directly from mining operations, during the twelve months ended March, 1924, totalled in value 17,384,090 dollars, an increase of 11,934,621 dollars on the previous twelve-month period. Shipments during March were valued at 2,028,885 dollars, a gain of 1,464,644 dollars compared with March last year. During the twelve months ended March, 1924, Canadian exports of silver, including bullion and silver contained in ore and concentrates, totalled 17,948,266 oz., valued at 11,539,783 dollars, an increase of 836,850 oz. and 80,791 dollars on the previous twelve-month period. Shipments during March amounted to 2,103,738 oz., valued at 1,337,339 dollars, a gain of 186,798 oz. and 71,838 dollars. During March 567,114 oz. of silver bullion, valued at 365,947 dollars, were shipped to the British Isles.

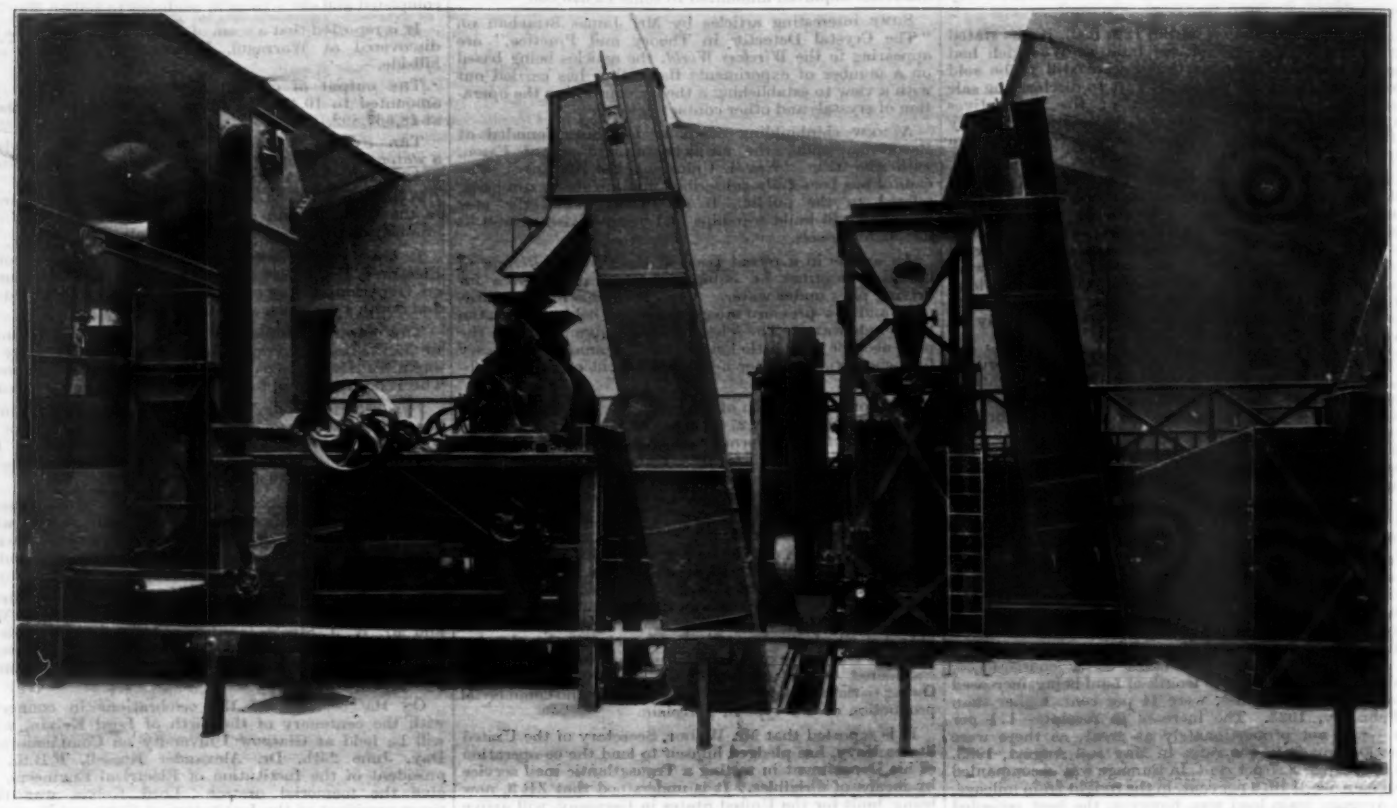
THE virtual completion of plans for the transmission of electrical power between Boston and Detroit, a distance of approximately 800 miles, has been announced by the Adirondack Light and Power Company. Lines of several other electrical corporations are involved in the undertaking. The direct interchange of electrical energy between Niagara Falls and Boston will be made possible by the construction of a 30-mile high-tension line between Syracuse and Oneida, which will connect the Niagara and New England producing fields for the first time and complete one of the longest high-tension systems in the world. The lines of four great electrical producing corporations in the East will be utilised on 500 miles of the project between Niagara Falls and Boston, making the Niagara energy available to east and north and connecting it with electrical developments in the Adirondack Mountains and New England steam plants.

FOR some time past the South Manchurian Railway has been conducting experiments with a view to the production of fuel oil from the oil shale obtained in the ordinary mining process employed at the Fushun coal mine in Manchuria. The results have been watched with considerable interest by many, and especially by the Japanese Navy Department, which is naturally anxious to develop new sources of supply of this much-needed fuel. As the result of these experiments, it is now claimed that the oil shale of Fushun is of a superior quality to that extracted in Scotland, that the cost of production is sufficiently low to allow competition with the present market prices in Japan, and that the shale should yield 8 or even 9 per cent. of oil. The company intends, if successful in securing the necessary assistance from the Government Departments concerned, to erect a 5,000,000-yen distilling plant, with subsidiary plant for producing ammonium sulphate and other by-products. With this plant, it is claimed that 700,000 tons of shale would give 50,000 tons of oil annually. If success attends this first effort, it is proposed further to exploit the shale resources, so that in time the enterprise may yield an amount of oil equal to the present yearly consumption of oil in Japan, namely from 700,000 to 800,000 tons.

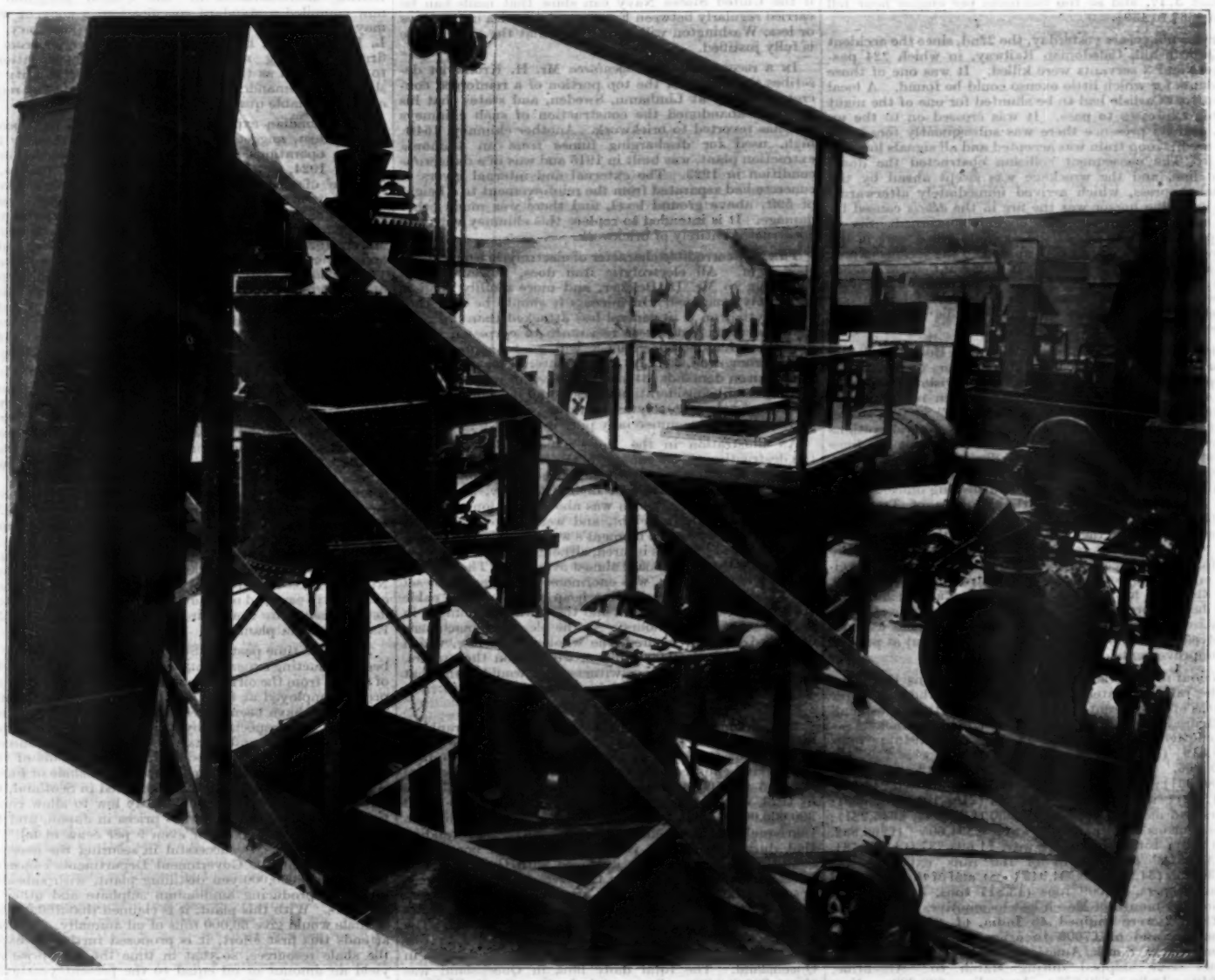
EMPIRE EXHIBITION—OIL-PALM FRUIT TREATMENT PLANT

MANLOVE, ALLIOTT AND CO., LIMITED, NOTTINGHAM, ENGINEERS

(*For description see page 584.*)



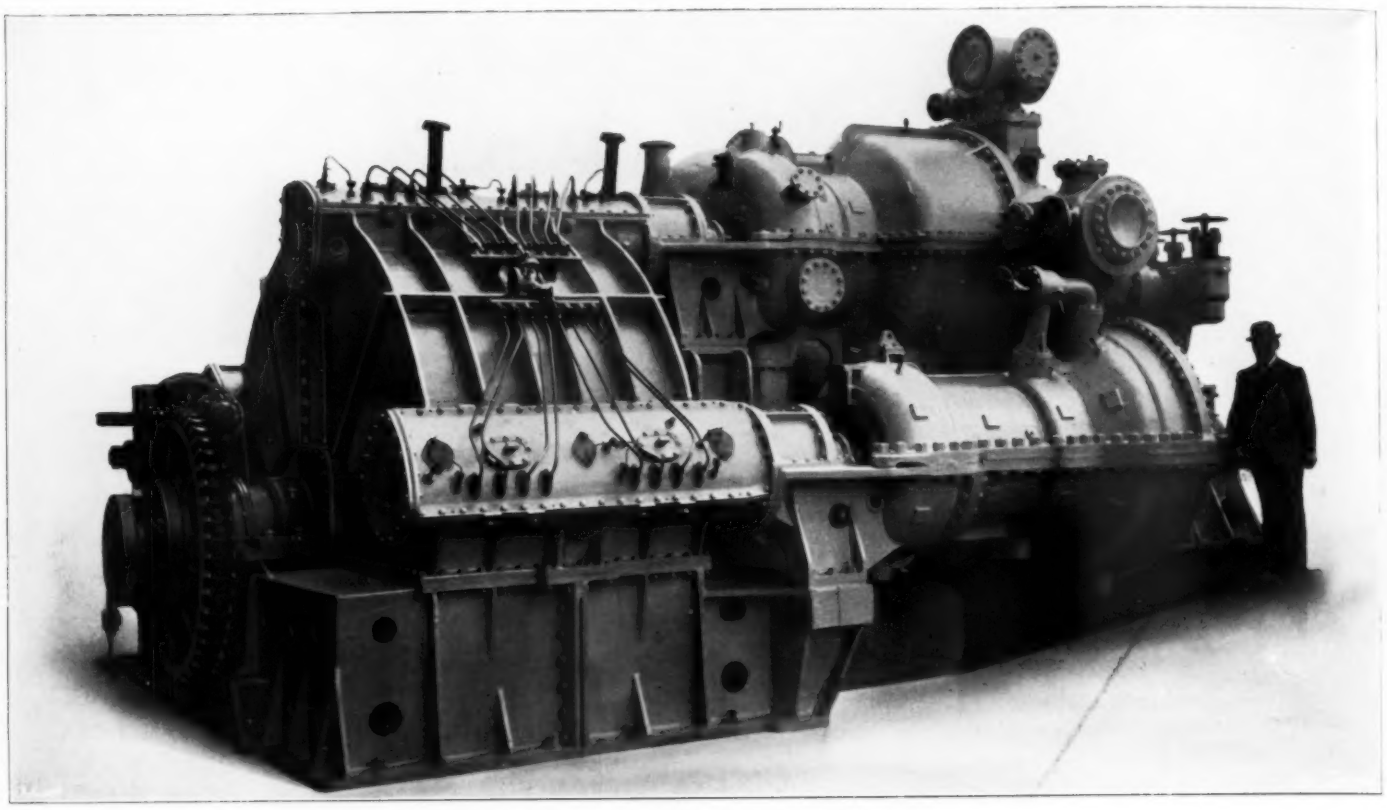
NUT CRACKING MACHINES AND AUTOCLAVE



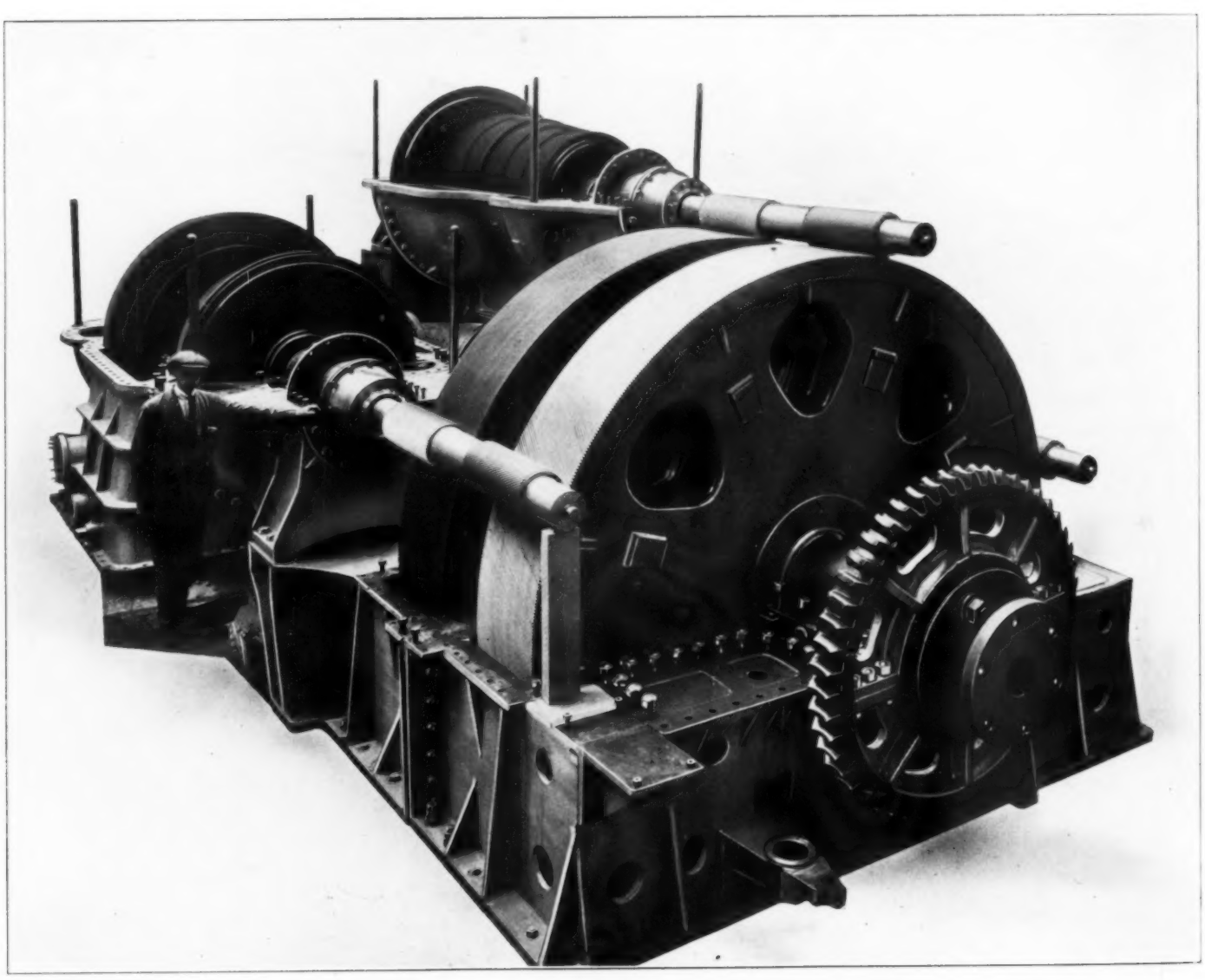
DIGESTOR, CENTRIFUGAL AND CHARGING PLATFORM OF ROTARY DRIER

SINGLE-REDUCTION GEARED TURBINES FOR T

VICKERS LIMITED, BARROW-IN-



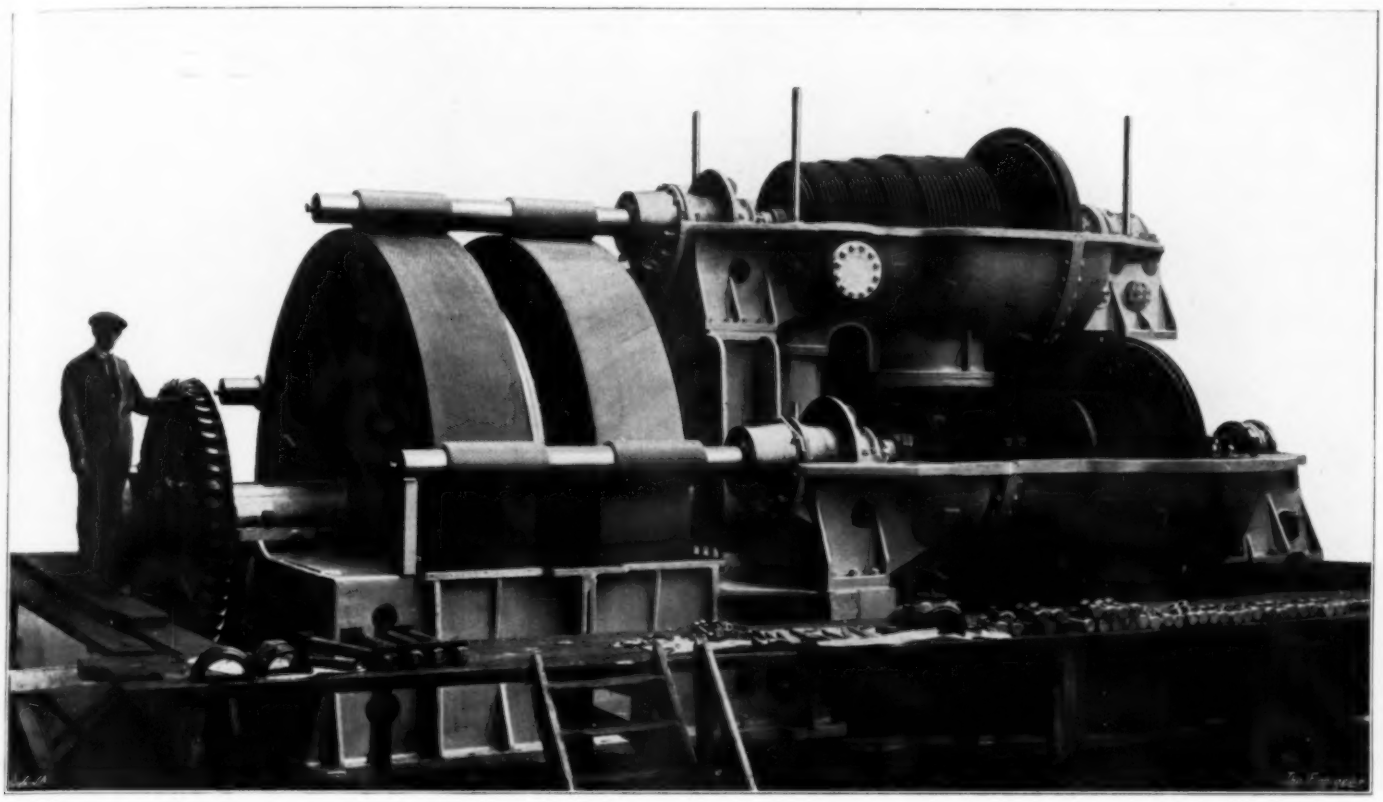
10,000 SHAFT HORSE-POWER TURBINE UNIT COMPLETE



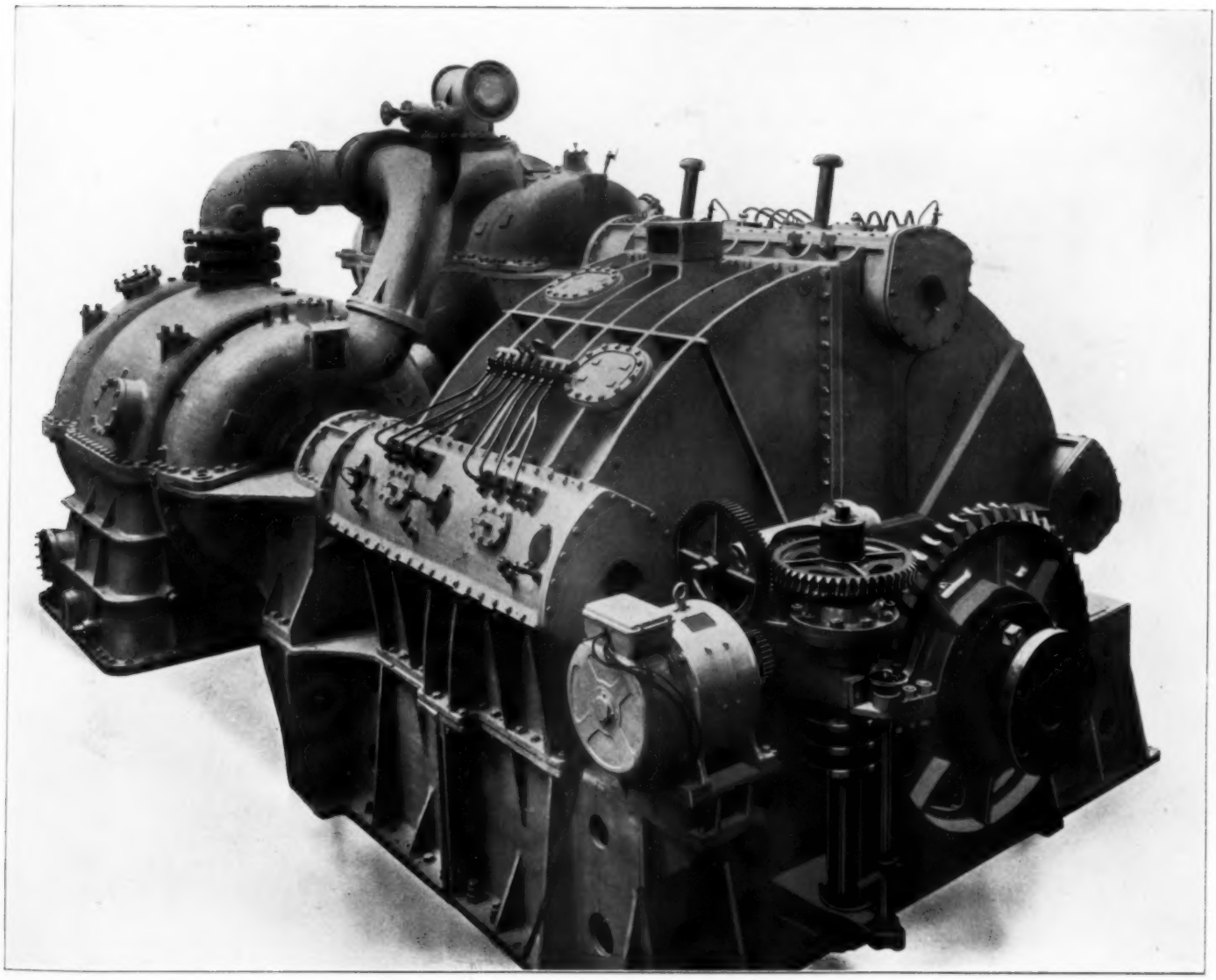
GEAR WHEEL AND PINIONS OF LOW AND INTERMEDIATE PRESSURE TURBINES

FOR THE TWIN-SCREW ORIENT LINER ORAMA

BARROW-IN-FURNESS, ENGINEERS



HIGH AND INTERMEDIATE PRESSURE TURBINES WITH COVERS REMOVED



VIEW OF COMPLETE TURBINE UNIT SHOWING ELECTRIC TURNING GEAR

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TWO-PAGE SUPPLEMENT—SINGLE-REDUCTION GEARED TURBINES FOR THE TWIN-SCREW ORIENT LINER ORAMA

DEATH.

ON Saturday, May 17th, Mr. JOHN MILLS, formerly principal of John Mills and Co., Railway Foundry, Llanidloes, in his eighty-first year.

THE ENGINEER.

MAY 23, 1924.

The Engineering Industries.

ON Wednesday, May 14th, Sir Allan Smith described, at a conference between the Engineering Employers' Federation and representatives of trade unions, the condition of the engineering industry at the present moment. It is impossible to say that the review had any bright aspects. Even in the abbreviated form in which it has been presented to the public—for the conference was held behind closed doors—it is gloomy, and there is no reason to suppose that the sample is unrepresentative of the whole. But no action of the Federation was needed to convince engineers that their industry is in a bad way. Its precarious position is all too obvious. Employment, it is true, is somewhat better than it was, more orders are going through the shops, and here and there a few firms are making sufficient money to pay dividends out of revenue, and to put some money away for maintenance, renewals and developments. But here and there there are "bright intervals," the industry as a whole is at the centre of a depression and covered by an impenetrable bank of clouds. Orders are being accepted at prices which leave little or no margin, and some of them would be carried out at a serious loss were it not that a portion of the material is imported from countries which are manufacturing more cheaply than we are. In short, very few contracts are being taken at their true economic price; most of them are accepted at figures which leave no margin of profit to devote to that improvement of plant and buildings which must go on incessantly if the power to compete with foreign manufacturers is to be maintained. This condition is one that may please the syndicalist, who is never more happy than when he sees capital in trouble; but it must cause the gravest anxiety to all who recognise that if the engineering industry be sacrificed the industrial pre-eminence of the United Kingdom will go with it. The welfare of the kingdom is bound up with its engineering industry, and unless that can be put upon a sure foundation, economic failure must come sooner or later.

Let us, now, look at some of the figures Sir Allan Smith placed before the Conference. In order to obtain statistics, the Federation instituted inquiries amongst all the federated firms, and received replies from more than one thousand of them, representing "65 per cent. of the employing power of the Federation." The returns covered (*a*) the whole of the last financial year; and (*b*) six months of the current financial year. The total value of the work in return (*a*) was about 150 million pounds. Of this sum over 63 millions were represented by materials, 30 millions by direct wages, and 20 millions by indirect wages, whilst standing charges of all kinds, income tax alone excepted, took nearly 30 millions. These figures are all in round numbers, and the actual net balance was £6,189,615. From this sum there is deducted remuneration to partners, directors and managing directors, at the rate of 1½ per cent. on the turnover—surely not an exaggerated allowance—and the final "balance available in the 1923 period is 2.73 per cent. That is all." Little enough indeed, but great compared with that of the returns for the current year, which show for the six months under review no more than .3 per cent.! That is to say, the credit balance for six months' work carried out by two-thirds of all the firms in the Engineering Employers' Federation is less than one-third of 1 per cent. That anything at all can be left for capital expenditure from such a small sum is clearly out of the question. But what else do these disastrous figures imply? Do they not show all too clearly that the improvement in the engineering trades is largely fallacious, that whilst more men are being employed and work is going through the shops, the finances of firms are at a far lower ebb than they were last year? No other deduction is possible, and it leaves no room for argument. The leaders of the trades unions—their spokesman at the Conference was Mr. Brownlie—affirm that the employers fail to make money because their works are not up to date and their methods behind those of other countries. We cannot accept that opinion; it is only arrived at by contrasting the most advanced foreign practice with the worst or the average British practice. But supposing it were true, where in the circumstances that are now revealed is the capital to be found for development and extension? It, obviously, cannot come from revenue, and, quite as obviously, it will not come from the investor. It is to be supposed that these figures were compiled by the Federation with the object of convincing the Amalgamated Engineering Union that the demand for an extra pound per week cannot be granted. But they show a great deal more than that, for they make it abundantly plain that, unless the volume of work can be greatly increased, thus leading to a decrease in the incidence of overhead charges, wages per piece must be decreased, or, before long, works will be forced to close down. No business can be conducted for long with a net profit of under one-third of 1 per cent. Sir Allan Smith pointed out that the result of reducing the hours from 54 hours per week to 47 was a reduction in output amounting to between 6 per cent. and 12½ per cent., but he added that he did not suggest a return to the old hours or a reduction of wages to the 5d. or 6d. an hour which was paid on the Continent. We speak for engineers as a whole when we say that they do not want to see actual wages reduced; indeed, most of them would willingly pay more if by so doing they could encourage the workpeople to turn out more work per hour. It is, as we have so often said, the wages cost per piece and not the gross wages that matter.

The figures presented by Sir Allan cannot fail to cause the liveliest anxiety. They exhibit in a definite collected form what has hitherto been known indefinitely and by piece-meal, that the engineering industries of the country are being run under wholly uneconomical conditions, and that the position is one of grave instability. The Federation has done well to put the matter clearly before the men's leaders, and it is to be hoped that in due course it will take steps to bring the figures before engineering employees all over the country. The men are as much concerned as their employers; the livelihood of both is at stake. An industry that cannot support itself is doomed. It may be carried on for a time by a draft upon more prosperous industries, but in the end it must die. That is the position that has to be faced by every one engaged in engineering. It can only be saved by a great decrease in the costs of production. That decrease must be sought first in the reduction of the cost per piece. When that is achieved the market will improve, the overhead charges will fall, and there will be more money to devote

to the improvement of manufacturing methods. We insist that wages need not fall. With harder work, with work even as hard as was promised when the 47-hour week was introduced, the position might be saved. But with the output per man at a very low ebb there is no chance of an improvement. We admit the position is difficult. We know that the temptation to "ca' canny" when work is short is enormous, and that employers themselves wink at it, if they do not actually encourage it, rather than discharge men. But it won't do. On both sides it is false policy. Nothing will succeed but a reduction in price and rapidity of delivery that will tempt the buyer. Mr. Brownlie stated that 10 per cent. of the members of the A.E.U. were unemployed. It might be better that more were supported by the dole for a time if, as a consequence, the remainder worked with an energy that would reduce the net cost of production, for evidence appears to indicate that high prices have more to do with the lack of orders than absence of demand. We observe with much satisfaction that the Government, on the motion of Sir A. Shirley Benn, has promised that a committee shall be set up to make a general inquiry into British trade. An inquiry of this kind, if conducted without bias and without prejudice, cannot fail to do good, and we trust that it may be established soon and that its report may be published with as little delay as possible.

The Flow of Steam Through Nozzles.

SLOWLY, but none the less surely, our knowledge of the true conditions governing and affecting the flow of steam through nozzles is increasing. The presentation of the Steam Nozzles Research Committee's third report last Friday to the Institution of Mechanical Engineers undoubtedly carried us a considerable stage farther towards a complete understanding of all the phenomena involved in the matter. It may seem to some, reading the account of the report and the discussion thereon which is printed elsewhere in this issue, that the Committee's work, so far, has lain along somewhat narrow and specialised lines, and that by choosing for its investigations certain commercial and fundamentally complex types of nozzle, the Committee has begun at the wrong end of its subject. The desire to obtain results of immediate value to the manufacturers who, through their trade association, are liberally assisting the research work—a desire that has, we are assured, been already realised—may perhaps have had some influence on the Committee when arranging the details of its programme. But it is now, thanks, we suppose, largely to Professor Mellanby's insistence, turning part at least of its attention to elementary nozzle forms, with the object of investigating the separate effect of each of the fundamental variables of which complex commercial types are compounded. Even though the Committee were not doing so, its programme of work could be defended against a charge of narrowness and specialisation. Very strikingly, an important phenomenon, the "flapping" of the jet, was discovered during tests on actual Parsons blading, the most specialised and complex form of nozzle tested. It is doubtful, we think, whether the Committee would have discovered this phenomenon and its cause, or at least would have done so at such an early stage, had it confined its attention to the less specialised impulse types of nozzle, although in the thick plate form of such nozzles the phenomenon has a definite and important influence on the efficiency. Had it studied only the elementary nozzle designed by Professor Mellanby, we cannot conceive that it would ever have discovered the phenomenon at all. It is true that the small and in some respects doubtful, but nevertheless highly interesting, effect of superheat on the efficiency was discovered while the elementary form of nozzle was under test. There is, however, no reason to believe that it would have passed undetected had one of the other types been in use, for the effect is, apparently, marked equally in them all, and was revealed, almost accidentally, as a result of an enforced change in the conditions of the steam supply. It may, again, be said that only with the elementary nozzles were clear signs received that the velocity coefficient, and therefore the efficiency, curve trends down towards zero at low steam velocities. This turning over of the curve was, however, predicted by Mr. Martin before the results of the elementary nozzle tests were known, and would doubtlessly have been established for the other nozzles, had they been tested at sufficiently low velocities. Moreover, while the downward trend is of great interest academically in the analysis of the factors affecting the genesis of the curve characteristics, it relates to the portion of the curve which is of the least practical importance.

While, however, the testing of highly developed nozzle forms can thus be defended, the systematic investigation of elementary types is strongly to be approved. Only by examining the effect on the efficiency of each separate factor of the nozzle form and arrangement will it be possible to pursue a logical and certain course towards the knowledge required to make improvements in established nozzle designs. In this connection, there is perhaps nothing in the Committee's third report more significant than the fact that the efficiency of the straight elementary nozzle was found to be at least 5 per cent. higher than that of any of the other forms tested. Such a gain in nozzle efficiency would be well worth securing in practice, and we are accordingly justified in asking the Committee to explain where and why the loss indicated by the comparison occurs in the practical nozzle types. Possibly, it may be a fictitious loss produced, not by the difference in the nozzle forms, but by the difference in the form of the box to which the nozzles were attached and the consequent difference in the steam flow conditions on the entry side. The Committee has, although by accident, lent some support to this view. By the successive application of packings and wedges to the nozzle pipe for the purpose of adapting the apparatus to the different nozzle arrangements tested, it unintentionally gave a very bad entry for the steam to the small Parsons nozzles. The resulting velocity coefficient curve reproduced almost exactly the form—but not the values—of the elementary nozzle curve. Possibly, on the other hand, the deficiencies may be caused, as Mr. Pochobradsky has suggested, wholly by the curvature of the steam passages in the practical nozzle forms. Whichever view is correct, it is certain that had the elementary tests not been undertaken, the deficiencies of the practical nozzles would not have been fully revealed, and that without farther elementary tests the precise cause of the deficiencies will be difficult to discover. Some additional tests with elementary nozzles are, Dr. Stoney has said, to be undertaken by the Committee, but from the information available as to their nature it may be legitimately doubted whether they will be of a sufficiently fundamental kind to meet the full requirements of the situation. Professor Mellanby, apart from his work on the Committee, has been conducting elementary nozzle experiments at Glasgow of a truly fundamental nature, and from the brief particulars of the results arrived at which he gave at last Friday's meeting, it may be concluded that the Committee has still a long way to go before its elementary work can be accepted as complete and satisfactory.

However we look at the subject, we are driven to the conclusion that, much as the Committee has so far done, it has still a great amount more to do before exhausting its utility. Its activities, begun under adverse conditions, in spite of the fact that they have yielded already considerable assistance to turbine designers, appear to us only now to be settling down to a logical course. We sincerely hope that it will be found possible to continue and extend them along the lines forecast in the third report, with a due and fair share of attention being paid to both practical and elementary nozzle forms.

Literature.

First General Report of the Lignite Utilisation Board of Canada. Published by the Board at 288, St. James-street, Montreal. March 15th, 1924. Price 1.50 dollars after free circulation is exhausted.

THIS is a very detailed and comprehensive summary of the experimental work done by the Board, which was created in 1918 by Order in Council of the Dominion Government, and covers operations extending from October 1st, 1918, to January 1st, 1924. Like many other researches which have taken place in the last decade, this one owes its origin to the Great War, a stringency in the matter of normal coal imports from America having led the Canadian Government to take up seriously the question of the utilisation of the vast reserves of lignite known to exist in the Dominion. Although Canada is the second greatest coal nation in the world as regards reserves, yet she imports half her requirements from America, owing to some extent, at any rate, to the fact that 77 per cent. of Canadian coal is sub-bituminous or lignitic. It was well known in Canada that lignite, or brown coal, as it is more generally called in Europe, was largely mined in the Continent of Europe, especially in Germany and Bohemia, and it was thought that its commercial exploitation for domestic use had been developed. This idea, however, was found to be erroneous as regards coking and briquetting of the char or coke. It was therefore necessary to work out a process and design plant *ab initio*. The work done in this respect at considerable expense has resulted in success, and it is on account of its novelty and importance to the various other lignite producing countries that we are giving a somewhat extended notice to the volume before us. In using the term "success" in the last sentence, we ought to qualify it by saying that though the practicability of carbonising and briquetting lignite has been proved, and a satisfactory plant evolved, the work still remains inconclusive as to its commercial aspects. The question still remains: Can these lignite briquettes compete in normal times with the imported fuel they are intended to replace? Here, it seems, we are face to face with one more of the numerous cases in which commercial developments made during the war, owing to the scarcity of this or that material, have gone to the wall since the scarcity has been removed.

The Board, not unwieldy in point of numbers, consists of R. A. Ross, Montreal, chairman; J. M. Leamy, Winnipeg, and the Hon. J. A. Sheppard, Moose Jaw, Sask., all unpaid, with Lesslie R. Thomson as secretary. These members acknowledge with gratitude the co-operation and assistance rendered by other individuals and corporations in America and England, the English names comprising Professor Bone, Dr. Rome (Rome and Campion), Peatral Syndicate, Limited, Low Temperature Carbonisation, Limited, and Fusion Corporation, Limited. Both the Canadian Department of Mines and the American Bureau of Mines have rendered active assistance, and close co-operation has been afforded by Dean E. J. Babcock, of the College of Engineering, University of North Dakota. Those responsible for the work under review must, we think, be congratulated on recognising that the object in view could be advanced most quickly and surely by a pooling of the ideas and suggestions of those intimately concerned with fuel problems; thus the work of individuals as well as of the various Departments of the Dominion concerned with the development of natural resources, became merged into a single Board with plenary powers for investigation.

Passing over the period of transition, in which much thought was given to the exact procedure to be followed—procedure which kept steadily in mind the demonstration of a commercial process of carbonising and briquetting—we come to the laboratory stage. Here the work carried out in Ottawa led to the patenting of the Stansfield carboniser and its practical trial at the large-scale plant shortly after erected on the coalfield near Bienfait, Sask. But disappointment was in store, and after extended trials, at of course considerable expense, these carbonisers had to be given up as a failure, mainly owing to constructional and operating difficulties. There is no need to enlarge upon the inherent difficulties of turning successful laboratory experiments into works practice on a large scale; the history of chemical engineering is replete with them, so the setback which the Lignite Board experienced will not surprise practical men. The drying of the lignite, which contains about 35 per cent. of water, seems to have given some trouble. The plant used was the cylindrical rotary dryer of the C. O. Bartlett and Snow Company, Cleveland, Ohio, consisting of four compartments heated by circulating waste gases, and owing to the low ignition point of lignite, it was found that there was a tendency for it to take fire. Later experiments showed that with careful regulation of temperatures, these dryers could be used for lignite without undue risk of firing. The dried lignite contains 5 to 6 per cent. moisture, and its storage proved to be a very difficult matter, the material being very liable to spontaneous combustion. The main causes of the first failures of the carboniser were due to leaky construction and failure of floor material, but even when these defects were remedied, others assumed prominence. Moreover, it was found that the briquetting plant was not suitable for lignite char. Hence, this chapter in the Board's work came to an end. Those who are interested will find detailed reports of the experiments in Appendices No. 22 to No. 26.

We have now to refer to the tests of the Hood-Odell carboniser at Grand Forks. In these trials a vertical oven designed by two members of the American Bureau of Mines was used. One hundred tons of screened lignite were sent for the trials, which were considered sufficiently successful to warrant the erection of an oven at the Board's works at Bienfait. It was also decided to make changes in the briquetting layout. The new oven at Bienfait had a gas-recovery installation, a slotted pipe with a metal curtain being inserted in the coal mass, directly above the upper combustion zone. The off-take was connected to the retorts and the line was continued to the power-house, where the gas was burned under the boilers. The air for combustion was provided by means of a Buffalo volume blower, which was connected to the four cast iron air ducts in the combustion zones, the pressure being half an inch of water. The oven was operated continuously for six months, and dealt with about 3000

tons of lignite. We take the following analytical figures from Appendix No. 27 :—

	Coal as charged.	Char.
Moisture	33.3 p.c.	Nil
Volatile matter	27.6 ,,	12.2 p.c.
Fixed carbon	32.7 ,,	72.7 ,,
Ash	6.4 ,,	15.1 ,,
B.Th.U. per pound	7399	11,800

The capacity of the oven was found to depend on several factors, but as much as 14 tons of char per twenty-four hours were obtained. It will be noticed that in this carboniser the moist lignite was dealt with, no previous drying, with its concomitant expense and worries, being carried out. It follows that the dangers attaching to dry lignite do not arise. The volume of gas recoverable, viz., 16,000 cubic feet per ton of lignite, was somewhat high, but its calorific power is only 110 B.Th.U. It is stated that the method of carbonisation materially reduces the yield of by-products, but that as they are of uncertain value, the objection is not material. An average of 3 gallons of tar per ton of lignite was obtained, and this tar on distillation gave 66.3 per cent. of pitch, which was subsequently used for briquetting. Attempts have been made to utilise the char direct as a fuel without briquetting it, but it seems that no success has been attained, its finely divided state leading to considerable losses in grate bars.

We turn now from the retorting of the lignite to the briquetting of the char. Before doing anything further in this way the Board arranged to get details of the work done at existing briquetting plants, the first report obtained being from the Nukol plant at Toronto. There the coal used is anthracite culm dredged from rivers and creeks in the Pennsylvania anthracite district. The binder employed is asphalt obtained from the Montreal refinery of the Imperial Oil Company. In this case it is necessary to dry the coal before use, two rotary type dryers, each 40ft. long by 4ft. inside diameter, being employed for the purpose. Full details of this plant and also of those subsequently referred to will be found in Appendices 28 to 31. The briquettes made from coal with 22 per cent. ash have the calorific value of 11,065 B.Th.U. per pound. At the works of the Anthracite Briquette Company, of Toronto, the Gambite process, which employs a binder of sulphite liquor and hydrolene combined, is used ; while at the important works of the North Dakota Mining Experiment Sub-station at Hebron the binder employed is a mixture of coal tar pitch and flour. It will be noticed that there is greater catholicity in Canada in regard to binders than in South Wales or on the Continent generally ; possibly cost has something to do with it, but there is nothing in the text to support that surmise. The nature of the binder will doubtless have some influence upon the calorific value of the briquettes, but as the figures from the different works refer to coals of varying composition, nothing definite can be deduced on the point. The calorific value of the Hebron briquettes is given as 11,462 B.Th.U., while the product of the Anthracite Briquette Company is stated to be 12,172. After an examination of the Hebron plant some large scale experiments were put through with the particular objectives of determining :—(1) Whether the char from the Hood-Odell vertical shaft oven could be briquetted satisfactorily ; (2) whether the percentage content of volatile matter made any difference in the product ; (3) whether lignite pitch as made from the tar could be utilised as a binder. To all of these objectives the result of the trials appears to have afforded a reply in the affirmative. Stove tests made in comparison with anthracite briquettes showed that the former gave decidedly more available heat per pound than the latter, and left less unburnt carbon in the ash. The lignite pitch was used in the ratio of 20 per cent. to 80 per cent. of coal tar pitch, as it was recognised that the quantity obtainable in a commercial retorting plant would not exceed that figure. Though of a more oily nature than ordinary pitch, it was found to mix well with it, and it is said to decrease the tendency for the mix to stick in the press rolls, by which we may take it that the mixed pitch is nearer to the desired soft medium quality than is the Canadian gas tar pitch by itself.

A considerable amount of work has been, and is being done, in America with regard to low-temperature carbonisation, with the recovery of by-products, and on behalf of the Board a number of producing factories were visited. In addition, tests on Canadian lignite are, we understand from the report, at the present time being carried out by Low Temperature Carbonisation, Limited, and the Fusion Corporation, Limited, in England. Some interesting details concerning the American works visited will be found in Appendix No. 16. A word or two about the carbo-coal process of Mr. C. H. Smith is all that our space allows of. At the large works erected at Irvington, N.J., raw coal is passed through horizontal retorts by means of a pair of screw conveyors, whereby it is heated to a low temperature for about an hour, coming out at the discharge end, partly freed of its volatile matter, as so-called semi-coke. This coke is pulverised and briquetted with pitch, the briquettes being subsequently heated at a high temperature for about four hours in inclined retorts. By this means the remaining volatile matter is driven off and the pitch binder is coked, the resultant product being a hard dense briquette resembling gas coke. The process is controlled by the International Coal Products Corporation of New York, and so far only coking coals have been dealt with. Experiments, however, are now in progress on Souris lignite supplied by the Board, and the results cannot fail to be of considerable interest, a remark which applies equally to the British experiments referred to above. A point which must not be overlooked is that while many patentees of carbonisation processes attach importance to the recovery of by-products, the Lignite Utilisation Board does not. One of the reasons, and certainly a potent one, is that the plants it is hoped to erect on the coalfields will be at a distance from chemical works or other possible buyers of the recovered products.

To sum up the work of the Board in a sentence or two, it has solved the technical problems of briquetting lignite char as produced in the Hood-Odell shaft oven carboniser, which it aided materially to develop for the purpose. A large plant of a solid permanent character has been erected at Bienfait in the coalfield, and this plant, though closed down for the present, can be put into commission again at any time. The existence of this full scale equipment, in which the satisfactory results recorded in the text of the report have been obtained, certainly seems to support the contention of the Board that it has solved the problem of manufacturing carbonised lignite briquettes. We shall await with interest the report testifying to a commercial success having been attained. Following the Appendices and occupying quite half of the total volume, are 14 plates and 64 figures, which render the report an important work of reference to those engaged in fuel problems.

Industrial Management. By RICHARD H. LANSBURGH. Chapman and Hall, Limited, 11, Henrietta-street, London, W.C. 2. Pp. 488. Price 22s. 6d. net.

THIS work definitely considers management as a profession in itself, and looks to good management to effect the saving of industry generally. The author tells us that in his handling of the subject, "operations have been treated with the belief that faith must be created in modern business, faith of the management in the employee, and faith of the employee in the management," and we find him frequently stopping at the close of a section to consider what the effect upon the worker is likely to be ; indeed, he gives definite evidence of failures in reorganisation solely attributable to the ignoring of the human factor in industry. It is instructive to compare "Industrial Management" from this aspect with former treatises on the same subject in which we shall find a good deal of space devoted to different methods of payment, distribution of duties, rate-fixing and the many functions with which management is intimately concerned—none of which are neglected by Mr. Lansburgh—but scant consideration of the worker himself, whereas in the work under review nearly 25 per cent. of the whole space is devoted to problems which are of primary concern to the worker. Let us take an example or two. In the section dealing with the organisation of the factory—Part II.—a chapter is devoted to *Morale*-building *v. Morale*-destroying Organisation, which can unhesitatingly be commended to the consideration of British engineers, for it presents the subject from an aspect which too often has been ignored entirely. Similarly, when dealing with the physical side—Part III.—emphasis is laid on satisfactory lighting and air conditioning, and the way to secure them. A whole section—Part VII. —is devoted to *Personnel* Relations, and we feel that the author has treated it in an admirable manner, his suggestions as to the employee taking part in the management being enunciated in exactly the right spirit. Too frequently in the past it has been assumed that the only way to secure the co-operation of the worker is to appeal to his cupidity, but by the application of Mr. Lansburgh's Foremen's Committees and Employees' Committees all are brought to realise that each has a definite part in the organisation, and that everyone's views and criticisms are welcomed. The idea has only been developed to a very limited degree in this country, but where it is used, success has attended the experiment.

When we come to the best methods of payment, and straight piecework is discussed, we naturally look for condemnation of the pernicious practice of rate-cutting, nor are we disappointed, and we realise more and more as we read, how great an asset the goodwill of the operator is, for where it exists if a price was originally too generous, owing perhaps to some palpable error, the Employees' Committee will of itself approve and even advocate an adjustment.

We are informed that there are two distinct methods of organising a factory—the military and the functional. In the former case, instructions descend from one authority to the next ; whereas in the latter, as its name implies, authority is functional, and a workman may have several "bosses," each helping him in one particular direction, one to see to the preparation for the work, another to look after speeds and tools, a third to supervise the quality of the work, and still another to see that the machine is kept in order. We are quite in agreement with the author, who advocates the "line and staff method" frequently applied in the United States, which "utilises the necessary flow of authority from top to bottom . . . with side eddies of authority flowing out from the main stream at different points along the line of supervision, in the form of functional or staff departments." It is thus a compromise between the military and the functional method.

The author states that in America "next to the 'efficiency man' the most unpopular phrase in the industrial vocabulary is 'welfare work'." The same remark could be applied to Great Britain, where so-called efficiency experts have done much to damage the cause of scientific management, but welfare work may be of untold value if conducted in the right spirit, and Mr. Lansburgh, abandoning the offensive word and speaking of "service work," gives a good lead in the manner in which it can profitably be employed.

It would not be difficult to criticise several of the author's statements, and we feel tempted to ask him several questions, as, for example, how many hands are employed in the factory for which he gives his typical organisation chart—Fig.4—containing upwards of thirty distinct departments, only one of which, that of the general superintendent, is presumably actually "producing the goods," or, again, when he is dealing with the vexed question of process specifications and route charts, in which he takes the simple case of a padlock as an example, how much clerical work and how many forms would be necessary to apply the same system to a larger assembly unit, *e.g.*, a locomotive ; but it is felt that no very useful purpose would be served by propounding queries and criticisms, the field covered being so large that problems could only be considered in a limited way. We should have liked to have seen more space devoted to the planning department, to the estimating and production departments, giving information as to the various forms of shop-load diagrams that have been adopted in different works, but if that treatment would have necessitated the curtailment of the number of pages devoted to the human equation, we should unhesitatingly advocate leaving the treatise as it is. These are relatively small criticisms of an excellent work. No one who is interested in industrial management will be disappointed by a perusal of it ; to the student it offers a mine of information, and for the seasoned manager it provides much food for thought and self-examination. There will not be many who emerge from a careful study of its pages without having preconceived ideas modified and the general perspective widened. It is readable from beginning to end ; it is clear and precise ; but first and foremost, its theme is treated in a sympathetic manner throughout—sympathetic alike to the humblest hand and to the man at the top of the scale.

SHORT NOTICES.

Alignment Charts for Engineers and Students. By W. J. Kearton and George Wood. London : Charles Griffin and Co., Limited. Price 16s. net.—The nomograph or alignment chart, although by no means a novel conception, has recently acquired a considerable and justly deserved degree of popularity among engineers and others who have to deal with the numerical interpretation of complex mathematical formulæ. Messrs. Kearton and Wood have now provided us with an excellent treatise on alignment charts, the theory underlying them, and the manner of their construction and use. The essential principle involved in the nomograph, namely, that a simple rectilineal equation of the form $y = m\,x + c$ can be represented by two parallel straight lines and a point, is not difficult to grasp even on the part of those whose mathematical studies have not been profound. From this basis the authors carry the reader on in an easy manner to a study of logarithmic and other more complex forms of chart, until at the end he should find himself in a very good position to make and apply alignment charts for practically all purposes.

Theory and Practice of Mine Ventilation. By Thomas Bryson. London : Edward Arnold and Co. 1924. 6s. 6d. net.—An excellent little book, dealing fairly exhaustively with the subject, in which the opening chapters contain a large amount of information usually found in text-books on physics and chemistry, but which, nevertheless, helps towards a proper understanding of the rest of the matter in the volume The process of natural ventilation is explained, while descriptions are given of all the principal fans for artificial ventilation. The flow of air in mines and the means used for its distribution are dealt with exhaustively. The book is profusely illustrated.

BOOKS RECEIVED.

London Guide No. 3. Published by London's Underground, Electric Railway House, Westminster, S.W. 1. Price 1s. net.

Spectroscopy. Volume I. By E. C. C. Baly. London : Longmans, Green and Co., 39, Paternoster-row, E.C. 4. Price 14s. net.

Automatic Telephone Systems. Volume III. By William Aitken. London : Ernest Benn, Limited, 8, Bouverie-street, E.C. 4. Price 55s. net.

A Dictionary of Applied Chemistry. Volume V. By Sir Edward Thorpe, F.R.S. London : Longmans, Green and Co., 39, Paternoster-row, E.C. 4. Price 60s. net.

The Year-book of the Scientific and Learned Societies of Great Britain and Ireland. Fortieth annual issue. London : Charles Griffin and Co., Limited, Exeter-street, Strand, W.C. 2. Price 15s. net.

Institution of Mechanical Engineers.

STEAM NOZZLE RESEARCH.

IT is almost exactly ten years since the Steam Nozzles Research Committee of the Institution of Mechanical Engineers held its first meeting. As an outcome of a paper read before the Institution in 1913, the Committee came into being three months before the fateful August of 1914. Little, however, was done to advance its objects during the war, and it was not until October, 1919, that any serious start with its research work could be made. Its first report was presented in January and its second in March of last year. The research work, carried out at the Dickinson-street and Bloom-street power stations of the Manchester Corporation has been considerably assisted financially by the British Electrical and Allied Manufacturers' Association, and through that body and the representatives of manufacturers on the Committee, the results already obtained have been made available to and have been utilised by makers of steam turbines and others interested in the flow of steam through nozzles.

The Committee's third report was laid before the Institution in London last Friday evening. It is very largely a statement of experimentally determined facts and figures, for the Committee, as previously, has refrained from discussing the significance of the research results. Taken by itself and apart from the previous reports, the general reader will no doubt find it hard to follow, and not a little difficult to appreciate its importance. We will therefore summarise it rather than reprint it verbatim, and, to make our account self-contained, will return when necessary to the first and second reports. A summary of these earlier reports, it may be said, will be found in our issue of March 23rd, 1923.

The Committee's prime object is to determine the efficiencies of various forms of nozzles used in steam turbines. Its method of doing so is to measure the impulse exerted by the steam jets on a plate arranged at a standard distance from the nozzles. From the value F of this impulse and the discharge m, the average *actual* velocity of the jet can be calculated from the formula $C_a = F\,g/m$. The *theoretical* velocity is determined from the temperature and pressure of the steam on the inlet side of the nozzle, and the pressure on the exit side. From these observed figures, the exit temperature can be calculated by the ordinary adiabatic equation, and knowing the two temperatures and the two pressures, the heat drop experienced by the steam in flowing through the nozzle can be determined by Callendar's formula for the total heat of dry steam. This heat drop is then equated to the kinetic energy of the jet, which proceeding results in the formula $C = 300.2\sqrt{d\,H}$, in which C is the theoretical velocity and $d\,H$ the heat drop. The velocity coefficient is given by the ratio C_a/C, and the efficiency of the jet is taken as the square of this ratio.

The experimental apparatus whereby the impulse of the jet, the two pressures and the inlet temperature are measured, is illustrated in Fig. 1. Its construction and operation were described in detail in our issue of March 23rd last year. It is sufficient here to repeat that the steam from the nozzles is directed vertically downwards on to a horizontal plate attached by a spindle, working in a frictionless gland, to a weighing lever, the plate having fixed to its upper surface a cage designed to remove all but truly radial velocity from the steam passing to the exhaust. Outside the cage the interior of the tester is filled with wire netting to destroy any eddies remaining in the escaping steam.

In the second report an account was given of the results obtained with (*a*) convergent impulse nozzles of 20 deg. nominal angle and thin (0.04in.) partition plates—see Fig. 2—and (*b*) 1in. standard Parsons 480 B nozzles of 20 deg. nominal angle. Fig. 3 shows four curves representing the velocity coefficients obtained with the impulse nozzles when the length of parallel throat portion was 3/1, 2/1, 1/1 and 0/1, as compared with the width of the throat. The shaded areas represent the estimated limits of accuracy of the observations in each case. The Parsons nozzles gave similar characteristic curves. In the course of the discussion on the second report, Mr. H. M. Martin showed that all the curves could be built up theoretically—as shown in Fig. 4—by assuming that at low velocities the flow was wholly viscous, at high velocities wholly turbulent, and at intermediate velocities partly viscous and partly turbulent.

It should also be recalled that on the same occasion Mr. Telford Petrie, the superintendent of the research work, made reference to the discovery of an important phenomenon, known as the "flapping" of the jet. The presence of some disturbing factor was detected in some tests with the Parsons nozzles. The cause was finally traced to the existence of a flat surface on the nozzle box about 2in. long below the lowest nozzle opening. The effect of this surface was to make the jet flap, and cause it to impinge on the impulse plate about 2in. out of centre. When the flat surface was chamfered off, the flapping disappeared.

In the third report, presented last Friday, particulars were given of tests carried out with (*c*) convergent impulse nozzles of 20 deg. nominal angle with thick ($^3/_{16}$in.) partition plates; (*d*) $\frac{1}{2}$in. standard Parsons 430 B nozzles of 20 deg. nominal angle; and (*e*) a set of straight elementary nozzles designed by Professor Mellanby.

The impulse nozzles were, as before, tested with varying lengths of parallel portions in the throat, the ratios to throat opening being 3/1, 1/1, $\frac{1}{2}$/1 and 0/1. The curves obtained were of the same general form as those given by the thin plate nozzles, but the velocity coefficients, and *a fortiori* the efficiencies, were in all cases lower, and in general considerably lower, than formerly. The nozzles as originally made—see Fig. 6—presented a flat surface about $^9/_{16}$in. wide at the exit end of each partition plate. Supplementary tests were carried out to determine the effect of chamfering the edges so as to diminish these flat faces and the "flapping" effect which previous experience indicated they might cause. The chamfer was made with a 6in. radius, as shown in Fig. 6, and later with a flat or plane surface. It was found that there was no material difference in the velocity coefficients obtained with the radiused and flat chamfers, but that the effect of both was considerably to improve the coefficients given by the unchamfered plates. The results of this portion of the research are summed up in Fig. 8. The coefficients given by the thick chamfered plates approach, except at high steam velocities, very closely to those obtained from the thin plate nozzles of the second report, while the non-chamfered thick plates, except at low velocities, give—as already stated—considerably poorer results.

Improved means of studying the efflux angle of the steam jets were devised and led to an important discovery. Previous work had shown that the efflux angle for the thin plate nozzles was about 17 deg., and not the geometrical angle of 20 deg. For the thick plate 20 deg. unchamfered nozzles, it was now found to be 14 deg., and for the same nozzles after chamfering 10.5 deg. On analysis, it was found that in all three cases the efflux angle, whether the plates were chamfered or not, was substantially

Fig. 1.—*Section of Nozzle-Tester*

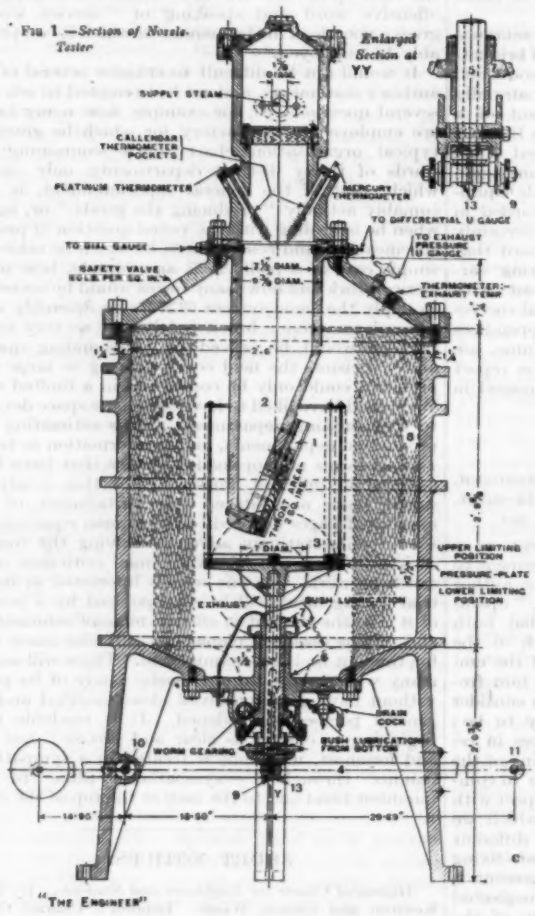


Fig. 2.—Impulse Nozzle-Box.

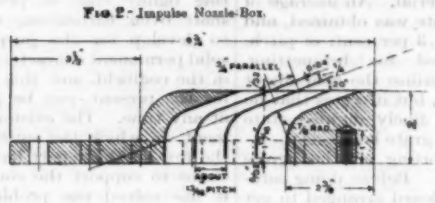
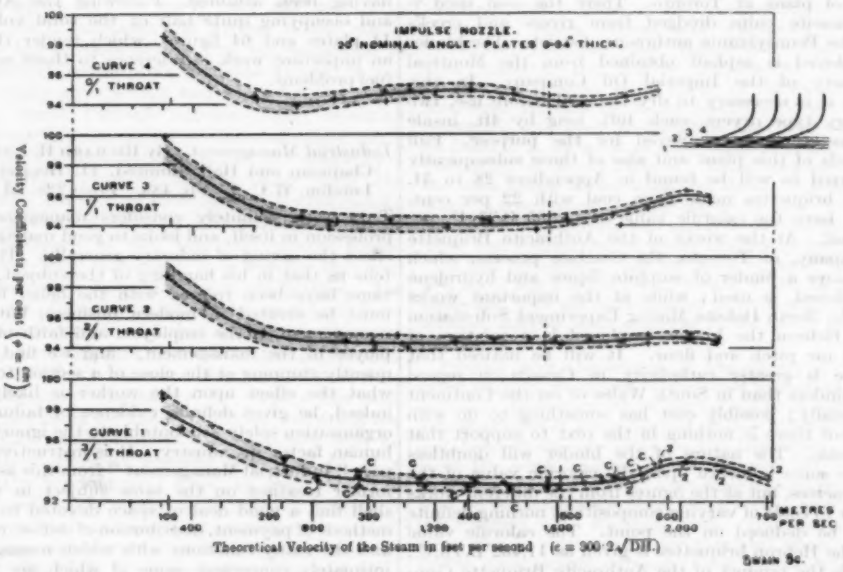


Fig. 3.



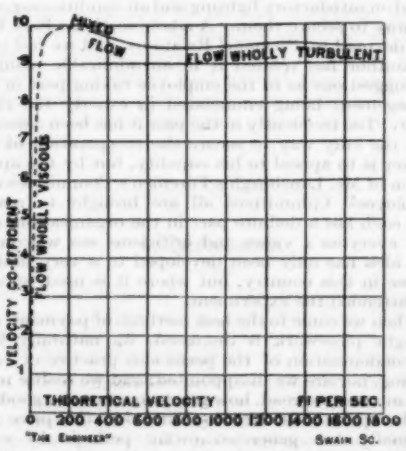


FIG. 4

equal to the angle indicated by the dotted line in Fig. 5, namely, an angle δ such that $\sin \delta = o/p$, and was not the angle θ defined by $\sin \theta = o/q$. This angle δ has been designated by the Committee the reference angle of the nozzle. In the case of the Parsons nozzle, the angle usually measured as the nominal angle is this angle δ. Thus for the 20 deg. Parsons nozzle shown in Fig. 5 the geometrical angle θ is about 37 deg., whereas $\delta = \sin^{-1} o/p = 20.5$ deg.

The $\frac{3}{4}$in. Parsons nozzles when tested gave a curve of velocity coefficients of the same form as the 1in. nozzles of the second report, but lying definitely below it throughout the whole range examined, indicating that their efficiency was materially less.

The elementary straight nozzles designed by Professor Mellanby are shown in Fig. 9. They were designed to have approximately the same hydraulic mean depth and the same total discharge as the curved nozzles already tested. It was found that the straight nozzles at steam velocities beyond 800ft. per second were at least 5 per cent. more efficient than any of the curved nozzles, that there was a distinct rise in the efficiency between 900ft. and 1600ft. per second, and that there was an indication of the "turning over" of the curve at very low velocities predicted by Mr. Martin—see Fig. 4.

The tests on these straight nozzles were carried out last summer, when the Dickinson-street station was closed down, and steam had to be obtained from low superheat. It was difficult, however, to place a figure on the improvement in the nozzle efficiency caused by reducing the superheat, for the difference between the two sets of figures was very close to the range of accuracy within which the coefficients could be determined. The Committee was now proceeding with tests on 12 deg. nozzles, and was continuing its work on the straight elementary nozzles. In the second named connection straight nozzles of varying diameter were being tested in order to determine the possibility of building up a curve showing the behaviour of straight nozzles when a constant quantity of steam was passed through them at different velocities.

Mr. F. Samuelson was invited to open the discussion, and, in doing so, briefly referred to the corresponding experiments which, he said, had been in progress in the United States during the past four years. That work, he remarked, had been carried farther than ours, but the general conclusions arrived at were the same. The broad tendencies of the curves were alike, and both sets showed a drop of efficiency at velocities of 600ft.–700ft. per second. The American efficiencies were, however, about 2 per cent. higher than the Committee's. That fact might be traced to the use by the American experimenters of reaction and not impulse as a means of arriving at the actual velocity of the jet, or it might be the result of a better inlet arrangement to the nozzles. He had every confidence in the work of the Institution's Committee, but he believed that the efficiencies of the nozzles of actual turbines were higher than those shown in the report. In this connection he referred to some recent investigations on the interstage efficiency of a steam turbine carried out by Professor Callendar, from the results of which he deduced that the average velocity coefficient over all the stages must be about 94½ per cent. The presence of moisture in the low-pressure stages would result in the velocity coefficient being less in those stages than the average figure, so that in the high-pressure stages the coefficient must be greater than 94½ per cent. He thought the time had now come when the Committee should turn its attention to the conditions prevailing on the inlet sides of the nozzles, instead of studying primarily the outlet conditions.

Professor A. L. Mellanby remarked that during the discussion on the second report he had drawn attention to the difficulty of explaining some of the fundamental features of the results in the absence of experimental data relating to elementary nozzles. The Committee had now partially supplied the required knowledge, but he himself had pursued the subject independently. He had applied the search tube method to determine the losses along the length of a parallel, rectangular-sectioned nozzle. The ordinary nozzle-flow formula had been adapted by introducing in it a factor k to represent the loss so that it became

$$0.718 \left(\frac{V_1}{P_1}\right)^{\frac{1}{n}} \frac{G}{A} = \frac{r(1 - k - r^{\frac{n-1}{n}})}{k + r^{\frac{n-1}{n}}}$$

in which V_1 was the initial velocity and P_1 the initial pressure, G the quantity of steam passing, and r the ratio of the pressure at any point along the length of the nozzle to the initial pressure. By means of his observed figures, he was enabled to calculate the value of the loss factor k at all points along the length of the nozzle. Using the nozzle first in a highly polished condition and then with the surface roughened by treatment with emery, he succeeded in separating the boundary loss from the total loss. The boundary loss was caused almost entirely by friction, and from its value he had calculated the coefficient of friction, and from that figure he proceeded to evaluate the velocity coefficient. Using the data thus obtained, he had calculated the velocity coefficients at several steam velocities for the Committee's straight elementary nozzle when tested with the Dickinson-street station steam. He found that his calculated figures agreed very closely with the experimentally determined coefficients. He therefore concluded that from the results of elementary experiments it was now possible to explain those obtained with nozzles of complicated form, in so far at least as friction was concerned.

Mr. B. Pochobradsky said that the elementary nozzle tests showed that there was little difference in the loss, whether the velocity was low, medium or high, say, from 400ft. per second upwards. One of the curves, it was true, revealed a reduction at a steam velocity of about 800ft., but, generally speaking, there was little variation in the loss as the velocity changed. On the other hand, in the case of the impulse and reaction nozzles, the tests showed that the losses were, in general, greater at high velocities than in an elementary nozzle. This fact, he believed, was to be ascribed to the curved path which the steam had to follow in those nozzles. The radius of the steam flow, he held, was of extraordinary importance, as was further shown by a comparison of the test results for the 1in. and $\frac{3}{4}$in. Parsons nozzles. The smaller nozzle had a sharper curve, and therefore the losses were greater than in the larger nozzle. Referring to Mr. Samuelson's remarks, he said he thought the difference between the American and our results would probably be found to be correctly explained by a difference in the inlet conditions. He urged upon the Committee the desirability of testing another form of impulse nozzle, namely, a modern type, machined all over, with sharp inlet and outlet edges, and having the maximum dimension about one-third of the length from the inlet end.

Mr. I. V. Robinson confirmed what Captain Sankey had said in a few introductory remarks, namely, that the manufacturers were very satisfied with the work carried out by the Committee. One important point that had been demonstrated was the increased efficiency which occurred at low velocities round about 400ft. per second. The manufacturers had already taken advantage of this result. Referring to Professor Callendar's investigations, he remarked that he (Professor Callendar) was about to carry out interstage efficiency experiments on behalf of the manufacturers' association—by which we understood him to mean the BEAMA—but that it would rest with the members of that body whether the results would be published.

Mr. Telford Petrie, the superintendent of the

FIG. 5.

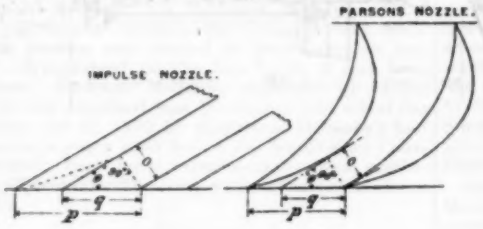


FIG. 6.

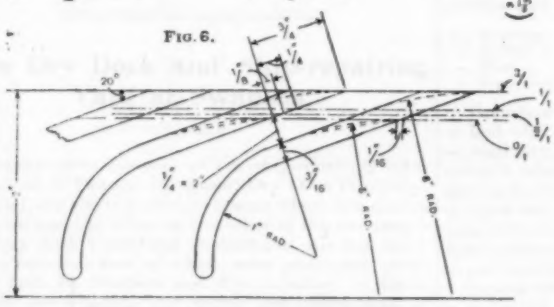
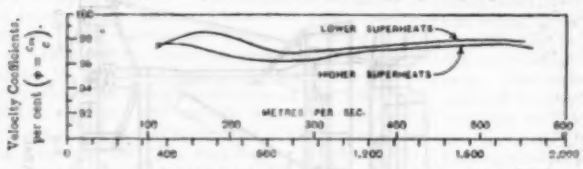


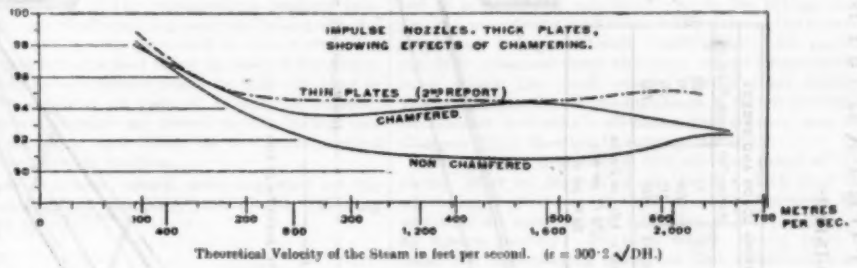
FIG. 7.—*Straight Elementary Nozzles showing Effects of Superheat.*



Theoretical Velocity of the Steam in feet per second. ($c = 300{\cdot}2\sqrt{DH}$).

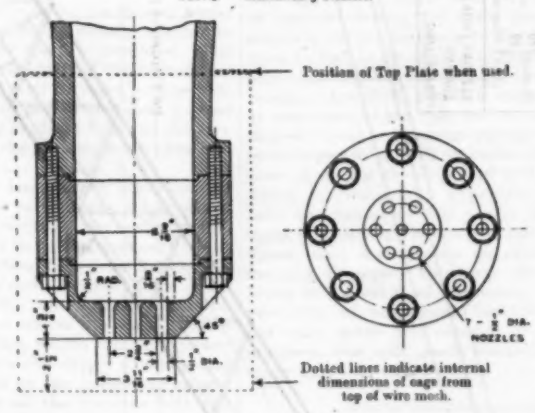
"THE ENGINEER"

FIG. 8.



Theoretical Velocity of the Steam in feet per second. ($c = 300{\cdot}2\sqrt{DH}$.)

FIG. 9.—*Elementary Nozzles.*

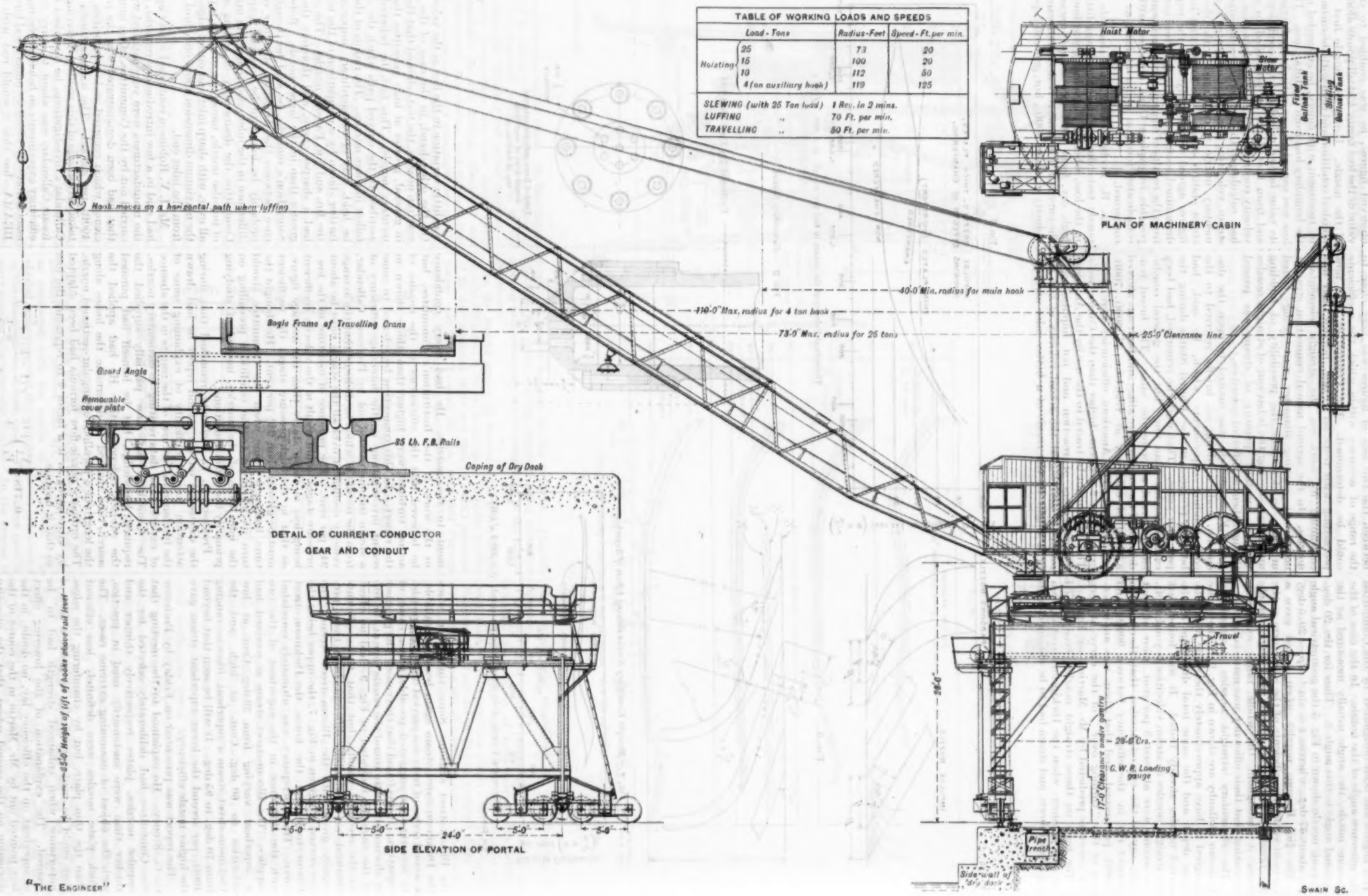

Position of Top Plate when used.
RAD.
45°
DIA.
7 - 1/2 DIA. NOZZLES
Dotted lines indicate internal dimensions of cage from top of wire mesh.

25-TON ELECTRICALLY-OPERATED PORTAL JIB CRANE

STOTHERT AND PITT, LIMITED, BATH, ENGINEERS

(For description see opposite page)

TABLE OF WORKING LOADS AND SPEEDS			
	Load - Tons	Radius - Feet	Speed - Ft. per min.
Hoisting	25	73	20
	15	100	20
	10	112	60
	4 (on auxiliary hook)	119	125
SLEWING (with 25 Ton load)		1 Rev. in 2 mins.	
LUFFING	,,	70 Ft. per min.	
TRAVELLING	,,	80 Ft. per min.	



DETAIL OF CURRENT CONDUCTOR GEAR AND CONDUIT

PLAN OF MACHINERY CABIN

SIDE ELEVATION OF PORTAL

"THE ENGINEER"

SWAIN Sc.

research work, gave some additional information concerning the effect of superheat on the efficiency of the nozzles. On analysis, he said, it had been found that the higher superheats gave apparently higher discharge coefficients, but lower efficiencies than the lower superheats. This result was paradoxical, but its real significance was that it was not safe to work with discharge coefficients in steam nozzle investigations. The figures given in the report showed that if in two tests the same force was exerted by the jets on the impulse plate, the higher the superheat the lower would be the actual discharge. In one selected instance there was 2½ per cent. less discharge for an increase of 24 deg. in the initial superheat.

Professor Stoney, replying to the discussion, said that he thought it quite possible that the test results might give lower efficiencies than those secured in actual turbines, for in all experimental work there were systematic errors that were inseparable from the method of experimentation followed. A well-known example of this fact was afforded by a comparison of the figures for the distance of the earth from the sun, arrived at by different methods. The differences revealed were found to be very much more than the probable error of any one method. He would like Mr. Samuelson to obtain the dimensions of the American nozzles, in order that the Committee might test them, and if Mr. Pochobradsky would supply a sample of the modern impulse nozzle box to which he had referred—a form of blading which was really of the small Parsons reaction type—it would no doubt be found possible to test that form also. He was very interested to hear from Professor Mellanby of the close agreement between the Glasgow and Manchester results, and desired to know whether any effect of superheat on the loss factor k had been detected. Professor Mellanby responded by saying that he was surprised that Dr. Stoney had asked the question, for in 1920 he (Professor Mellanby) had shown in a paper read before the North-East Coast Institution that both experimentally and mathematically superheating reduced the efficiency of steam nozzles.

New Dry Dock and Ship-repairing Yard at Swansea.

No. II.*

OUTSTANDING features of the ship-repairing establishment of Palmers (Swansea) Dry Dock Company, Limited, are the two electric cranes which run one on one side and the other on the other of the company's new dry dock which was described in our last issue. These cranes, views of which were given last week, were built by Stothert and Pitt, Limited, of Bath, to the specification and under the instructions of Mr. N. G. Gedye, M. Inst. C.E., the consulting engineer to Messrs. Palmers. The larger is designed to lift 25 tons at 73ft. radius, 15 tons at 100ft. radius, 10 tons at 112ft. radius, and 4 tons on the auxiliary hook at 119ft. radius, while the smaller can deal with a load of 10 tons at a radius of 59ft. The 25-ton crane operates on the western side of the dock and the 10-ton crane on the eastern side. The carriages of both are of the portal type, that of the larger crane having a span of 28ft. 6in. and a clear height of 17ft. under the portal. The total weight of the 25-ton crane in working order is approximately 220 tons. The crane is electrically driven, the current supply being three-phase, 50 cycles, 440 volts.

The level luffing gear is designed in accordance with the "Toplis" patented system, the general principles of which are, our readers may be reminded, as follows:—The auxiliary hoist rope is led over a pulley at the top of the superstructure frame to a pulley near the jib head, thence back again to the superstructure frame and finally to the jib head pulley and hook. The positions of the pulleys are so chosen that, while luffing-in, the amount of rope paid out so as to allow for the shortening of the distance between the jib head and the superstructure frame exactly compensates for the rise of the jib head. In the case of the main load the rope is led from the barrel over pulleys on the superstructure frame and jib head, to the snatch block and thence back again over pulleys on the jib head and superstructure frame to a central enlarged portion of the luffing barrel. Connection to the luffing barrel is made in such a way that, when the luffing ropes are being wound in, the tail end of the hoisting rope is being paid out, and the diameter of the central portion of the barrel is so chosen that the speed of paying out of the hoisting rope compensates for the rise at the jib head. The load is therefore always maintained at the same level.

The hoisting barrels are driven by means of treble-purchase machine-cut gearing, and three speeds are provided for each barrel. Both barrels are driven from the same motor, clutches being provided to engage the main or auxiliary barrel as may be required. The changes in speed are effected by means of sliding pinions. The luffing barrel is driven by one reduction of spur gearing and one reduction of worm gearing, the latter being enclosed in an oil-tight case. The outer ends of the luffing barrel are grooved to receive ropes connected to a sliding balance weight which is arranged at the back of the crane to balance off the weight of the jib. These ropes are led off the opposite sides of the barrel from the luffing ropes and the same side as the hoisting ropes, and the combined action of all the ropes is such that the barrel is in balance and would not rotate even if disconnected from the gearing. A high speed of luff can thus be obtained with a comparatively small expenditure of power. The revolving part of the crane is carried on a live ring of steel rollers, and slewing is effected by means of a pinion gearing with a pin type rack and driven from the motor through worm and spur gearing. The worm gear in this instance also is enclosed in an oil-tight case.

The crane travels on sixteen wheels provided with central flanges to suit twin rails. These wheels are arranged in compound bogies, four at each corner of the crane, two wheels at each corner being geared for travelling. The travelling motor is situated above the portal and transmits its drive through suitable cross and vertical shafts to the rail wheels. The maximum loads on the four wheels of one bogie with maximum working load at 73ft. radius and wind pressure calculated at 5 lb. per square foot is 25¼ tons per wheel.

As will be gathered from the illustration on page 576, the jib of the crane is exceptionally long, measuring, as it does, 120ft. from the centre of the heel pin to the centre of the auxiliary lift shears at the jib head.

Brakes are provided in all the motions. In the case of the hoisting motion the load is usually lowered under the restraint of the regenerative braking incidental to the use of alternating current, but a powerful emergency brake is also provided to lower the load under the control of a foot lever in case of necessity, and there is also a solenoid brake to hold the load or to check its descent in case of failure of current. Similar solenoid brakes are fitted on the luffing and travelling motions, and there is a hand-operated brake for the slewing motion.

The electric motors, which were supplied by the Metropolitan-Vickers Company, are of the following powers and speeds:—

Hoisting	50 H.P. at 570 r.p.m.
Luffing	30 H.P. at ,,
Slewing	25 H.P. at ,,
Travelling	40 H.P. at ,,

The whole of the machinery in the machinery house is laid out on the flat, so as to obtain maximum accessibility, and ample floor space is provided. The driver's cabin, in which are assembled the controllers and brake levers, is carried well forward on one side of the crane, with a view to giving the man a clear view of his work. A sloping skylight over the driver's head enables a clear view of the jib head to be obtained in any position of luffing.

Current is collected from bare trolley wires carried in a conduit adjacent to the rails on the dock side of the track. The plough carrying the collectors is hung from one of the bogies in such a manner that it can swing to adjust its position to accommodate any irregularities in the track or cross motion of the crane due to clearance between the wheel flanges and the rails. The centre pin round which the crane rotates is bored to receive the cables, which transmit power from the trolley collectors to the driver's cabin, and also from the driver's cabin to the travelling motor. Limit switches are fitted on all the motions with the exception of the slew.

There are ladders to give access to all parts of the crane, and a small platform is fitted near the jib head, so as to facilitate attention to the jib top pulleys. These pulleys are of a patented pressed-steel self-oiling type.

The crane was subjected to a test load of 31¼ tons in all motions and a static load of 50 tons, or double the working load.

The crane track has been constructed on the west side of the dry dock and extends the entire length of the dock from the entrance to the inner end. The crane is thus not only able to deal with loads in any part of the dock, but it also commands a considerable part of the berth in the King's Dock adjoining the entrance to the dry dock. When the proposed second dry dock, adjoining the one just completed and parallel with it, is constructed, the 25-ton crane will be able to serve both docks.

The smaller crane, which in several respects is a replica of the larger, does not call for particular description. We may here say that Messrs. Stothert and Pitt, in addition to supplying these two cranes, also furnished a 20-ton overhead travelling crane which spans the large fitting shop of which mention is about to be made. The latter crane is operated electrically, and all its motions are controlled from ground level by means of depending wires provided with handles. In addition to the two large dock cranes there is also a 3-ton steam travelling crane, with a 45ft. jib, for general dockside and shop work.

The equipment of the workshops in the ship repairing yard leaves nothing to be desired. There is a large collection of excellent machine tools of modern type which have been well chosen to cope with any kind of repair work which the company is likely to be called upon to perform. It is claimed, and, we think, with reason, that the machinery equipment for repair work to vessels and their machinery not only surpasses anything existing in neighbouring ports, but also compares favourably with anything to be found elsewhere.

Arranged parallel to the dry dock and between it and the King's Dock entrance lock is a row of buildings 355ft. long, 45ft. wide, and 30ft. high. Of the total length, 160ft. is devoted to the fitters' shop, the remainder being divided up into plumbers', blacksmiths', joiners', carpenters', paint shop, &c. The tools in the fitting shop include high-speed lathes, planing, shaping, boring, screwing and sawing machines, all of them electrically driven and all arranged with a view to dealing expeditiously with work. It is this shop which is spanned by the 20-ton overhead crane previously mentioned. The platers' shed, which is at right angles to the row of shops just alluded to, is at the south side of the site. It is a roomy building measuring 230ft. in length by 75ft. in width and is 27½ft. in height to the eaves. It is certainly among the best laid out and appointed shops of its kind that we have seen the machinery with which it is furnished being of a very high class. On entering the building one is immediately struck by the imposing appearance of a fine set of plate bending rolls made by Hugh Smith, Limited, of Glasgow, which are certainly large enough to deal with the largest and heaviest plates requiring treatment. Then there are plate edge planing machines, punching and shearing machines, plate mangles, countersinking machines, a beam bender and angle cutting machine, bending blocks, &c., as well as large plate and bar heating furnaces. Provision has been made for installing a 5-ton overhead electric crane in this shop, but at present it is not fixed. As in the fitting shop, &c., the machinery is all electrically driven, the current employed being 440-volt three-phase, 50 period, which is obtained from the same transformer station from which the dock cranes derive their energy. The contractor for all the buildings in which the shops are housed, and which all have steel frames, was the Glasgow Steel Roofing Company, Limited.

The general impression left on the mind of the visitor after an inspection of the dry dock and the adjoining workshops is that in them Swansea has acquired an asset which will play a leading part in its future history. Nothing which would tend to make the undertaking a success and would render it capable of dealing efficiently and expeditiously with any class of shipping repair work which may come its way appears to have been forgotten. The site, too, is happily chosen, for since the dry dock is closely adjacent to the entrance to the King's Dock, no time need be lost in getting an injured vessel into dry dock and under repair. Moreover, the fact that there now exists a dry dock which is capable of being entered at any state of the tide and of taking in not only the largest vessel at present trading to South Wales, but even larger ships, will undoubtedly have an important bearing on the development of the port, the trade of which is continually expanding. Already just to take one example the yearly importation of petroleum oils and spirit has reached a very considerable figure, and it continues to grow. The business of keeping in repair the large fleet of tankers which bring in the oil is of increasing importance, and the provision of additional facilities for repair should not only invite the coming of oil boats in greater numbers, but will nearly certainly attract vessels of other types as well.

* No. I. appeared May 16th.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

G.W., N.E., AND G.N. LOCOMOTIVES.

SIR,—The comparative tables given in your issue of 16th inst. make a very interesting study in reviewing these latest examples of high-power locomotives. On the basis of cylinder and boiler capacities there is little to choose between either of the three; but in the three-cylinder types, the blast effect is different to that of the four-cylinder engine. This difference is most pronounced at low speeds, especially with heavy loads, though whether it counts for anything under daily running conditions, I am unable to say; but blast effect is worth consideration in comparing the two types.

In the early 'eighties the Worsdell-von Borries two-cylinder compounds on the G.E.R. were indifferent steamers, owing to the comparatively infrequent blast, though the mitigated disintegrating action on the fire-bed had its compensations. Mr. James Holden, in replacing these compounds with his 2-4-0 No. 710 class locomotives, fitted special adjustable blast nozzles varying from 4¼in. to 5in. diameter, with the object of obtaining the maximum blast efficiency with the minimum of fuel waste.

If there is any virtue in the intermittence of the blast, the advantage would lie with the four-cylinder, four-blast cycle, rather than the three-cylinder, six-blast cycle.

Rhyl, May 20th. H. V. PEGG.

THE city of Paris has opened a competition for new types of street furniture, lamp-posts, electric lamps, tramway standards, pillar boxes, fire alarms, fountains, sand boxes, kiosks, entrances to the Metropolitan Railway, shelters, seats, &c. The Council wishes to find artistic models with a decidedly modern tendency, and all copies or imitations of old styles will be eliminated. Prizes to the value of 40,000f. are to be distributed. The competition will close on October 11th, and the jury will make its awards before the end of the year, so that full-size models can be executed in time to be shown at the International Decorative Arts Exhibition to be held next year.

Further Experimental Work on Diesel Engines.*

By ENGINEER-COMMANDER R. BEEMAN.

(*Concluded from page* 548.)

4. RATE OF HEAT FLOW AND ITS ATTENDANT STRESSES.

AMONGST the difficulties attending the development of high mean pressures is that of accommodating, without excessively stressing the parts exposed, the resulting high rate of heat flow through the walls of the combustion chamber. Even in engines developing moderate mean pressures the heat stresses in the parts comprising the combustion chamber may be of a very high order, if careful attention is not given to the design. Evidence of this is found in the numerous cases of cracked cylinder covers and pistons which come to notice. For an engine designed to develop high mean pressures, it follows, therefore, that the design of cylinder liner, cover and piston, requires very critical consideration if they are to withstand successfully the severe conditions under which they are intended to operate. When designing the Digit engine in 1918, the importance of this aspect was borne in mind, and some special cooling features were introduced. In particular, attention was directed to the more efficient cooling of the head of the cylinder liner than is usually the case in the ordinary engine, and provision was made by circulating the cooling water in direct contact with the liner head.

TABLE IV.—*Heat Balance of Digit Engine.*

Mean pressure, 142 lb.; revolutions per minute, 390; indicated horse-power, 442; calorific value of fuel: higher, 19,300; lower, 18,100 B.Th.U.

Heat supplied.	Heat accounted for.		Per-centage.
B.Th.U. per min.	B.Th.U. per min.		
By fuel .. 38,480	Brake horse-power ..	14,255	36.7
By air .. 330	Mechanical friction ..	4,450	11.5
	Jacket and cover ..	4,850	12.5*
	Exhaust valve	545	1.4*
	Piston cooling oil ..	1,050	2.7*
	Exhaust gases	12,225	31.5
	Radiation, &c. (by difference)	1,435	3.7
Total .. 38,810	Total	38,810	100.0

* 16.6 per cent. total loss to cooling media at engine.

Of the stresses obtaining in the three important members comprising the combustion chamber, viz., cylinder head, liner and piston, those due to the heat flow are, at the heavier loads, greatly in excess of those resulting from the combustion pressure. The necessity, however, for considering the probable effect of the combined operation of these two stresses is obvious. Whilst an accurate forecast of the heat flow stresses is not possible, certain deductions can be made, based on the ascertained heat transmitted to the cooling jackets of the members concerned, whereby the distribution of the heat flow may be assessed approximately, and from such approximation some indications of the stresses to be expected may be calculated.

A heat balance sheet drawn up from a six-hour test on the Digit engine when developing 142 lb. mean pressure at 390 revolutions per minute is given in Table IV.

From such calculations, the maximum heat stresses appear to be of the following order:—

In cylinder cover ..	30,000 lb. per sq. in. (steel casting)
In cylinder liner ..	9000 lb. per sq. in. (cast iron)
In piston	9000 lb. per sq. in. (aluminium alloy)

The fact that stresses of the above order can arise, derives support from the failure of this cylinder cover. In the design stage it was anticipated that an appreciable advance in mean pressure would be attained, and although some provision to this end was made in the cylinder cover, it was hardly hoped that the power development would be carried to the present high figure. The failure of the cover, therefore, which was a steel casting, was not altogether unexpected, and the new design will embody special features to meet the higher mean pressures now found possible of attainment.

The liner of this engine has proved suitable for the higher powers. In view of ultimate developments, however, the laboratory is taking what may perhaps be regarded as anticipatory measures in testing a forged high-carbon steel liner in the Unit engine. The head portion, being of the same diameter as the cast iron liner that it has replaced, is heavier than necessary, but the body thickness is much less, and as a result a considerable reduction in the stresses due to the heat flow is effected. It is expected, and so far has been confirmed by tests, that the steel liner will also afford marked relief from the excessive wear that often obtains in cast iron liners in the vicinity of the head. Up to the present date, the steel liner has given very promising results, and, should further running justify expectations, this type of liner will afford considerable scope for high-duty work, as well as for replacing cast iron liners that are found to wear badly. The behaviour of the Digit aluminium alloy oil-cooled piston has already been referred to, and it will suffice to remark that it is anticipated that increased thermal loading can be carried by it.

As a further step in increasing the power developed in the cylinder to very high limits, the possibilities of supercharging have not been overlooked. Up to the present time, however, it has not been possible to carry out supercharging tests in the Digit engine. The earlier experiments on the Unit engine justified the expectation that by this means the attainment of a higher power per cylinder may be advanced a further stage, and this research will follow logically when the possibilities of increasing the mean pressures by direct means are fully exploited, and further experience becomes available of the improvements in the design of the members exposed to heat stress.

LUBRICATING OIL CONSUMPTION.

Means of reducing the quantity of the lubricating oil passing the pistons has received special attention during the experimental work. The deleterious effects of excessive leakage need hardly be emphasised. Experiment shows that with pistons of the ordinary desgn, with rings in good working condition, it has not been possible to keep the lubricating consumption down below 4 to 5 per cent. of the fuel consumption. The consumption can, however, be reduced appreciably by slightly chamfering the piston for short distances below the scraper ring and the lower gas ring, and by providing at these positions a number of small relief holes drilled in through to the inner sides of the piston. Prolonged running of the several engines with this arrangement has demonstrated that the consumption can be kept down to about 1½ per cent. of the fuel used. Experience with other devices suggested—as, *e.g.*, chamfering of the scraper ring to allow it to pass oil on the upward stroke and remove it on the downward stroke—has not proved them to possess any material advantage.

It may be of interest to note that in the Unit engine direct cylinder lubricating feed is not employed, it having been found that splash from the moving parts is sufficient.

Typical results from a series of carefully conducted lubricating oil-consumption trials on the "H" class engine, with all conditions similar except for a variation in the amount of direct cylinder wall lubrication supplied, are shown in Table V. At the end of the first trial some

TABLE V.—*"H" Class Engine.—Results of Lubricating Oil Tests.*

Trial.	1	2	3
Duration of trial, hours	72	72	72
Average revolutions per minute	375	375	375
Average brake horse-power ..	30	30	30
Average fuel per hour, lb. ..	12.69	12.61	12.64
Fuel per brake horse-power per hour (excluding compressor), lb.	0.423	0.420	0.421
Blast air pressure, lb.	950	950	950
Temperature of exhaust, deg. F.	602	608	603
Compression pressure, lb. ..	490	490	490
Initial pressure, lb.	620	620	620
Loss of crank case oil, lb.	16.1	8.7	10.20
Cylinder wall oil supplied, lb. ..	1.4	5.3	3.55
Total lubricating oil consumption, lb.	17.5	14.0	13.75
Lubricating oil consumption per hour, lb.	0.243	0.195	0.191
Lubricating oil/fuel oil, per cent.	1.91	1.55	1.51
Bearing oil pressure, lb. sq. in...	7	7	7
Flash point at commencement of trial, deg. F.	392	393	388
Flash point at end of trial, deg. F.	393	388	390
S.G. at 60 deg. F. at commencement of trial	0.897	0.896	0.896
S.G. at 60 deg. F. at end of trial	0.896	0.896	0.897
Viscosity at 60 deg. F. at commencement of trial, secs. ..	1430	1530	1530
Viscosity at 60 deg. F. at end of trial, secs.	1530	1530	1630

of the piston rings were gummed; after the second trial they were all free, and on the completion of the third, two rings were partially stuck. It appeared necessary, therefore, in this particular engine to supply a certain quantity of direct feed, and this had been confirmed subsequently in other tests. The maximum amount supplied was three drops per minute through a mechanical lubricator.

ALTERNATIVE FUELS.

In the naval service provision is made for separate supplies of suitable oil for use in oil engines and the ordinary fuels supplied for use under boilers are not customarily supplied. Necessity or convenience may

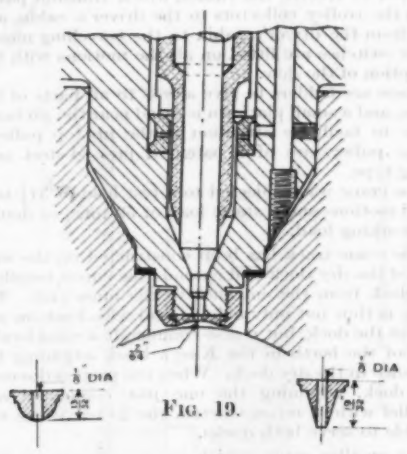


FIG. 19.

FIG. 20. FIG. 21.

"THE ENGINEER" SWAN SC

FUEL INJECTION VALVE AND NOZZLES

on occasion entail other fuels being employed, and while a considerable amount of scattered data is available from the fleet and elsewhere, it was judged desirable to exploit the possibilities of other types of potential fuels in the laboratory to obtain complete and reliable data for guidance. Experiments have accordingly been carried out on the small "H" class engine, and comparative trials have so far been carried out with shale, Texas, palm, mineral lubricating, and Mexican oils. In this design the compressor for the blast injection air is separately driven, and in the table of results following no correction has been made for the consumption for this detached unit. The fuel-injection valve is of the simple Diesel type, *i.e.*, fitted with pulverisers near the base of the spindle and a single orifice for the passage of fuel and air into the cylinder. In carrying out the foregoing experiments it was desired to maintain all fittings on the engine similar to those used for the shale oil trials, and beyond the provision of heating arrangements for the palm and Mexican oils it was found necessary to make any modification, with the exception of a special type of sprayer cap in the case of the last named oil. Subsequently this sprayer cap has been found satisfactory with other fuels. The shale and Texas trials were run to afford a basis for comparison and call for no special remarks. In the case of the palm oil trials it was found that the best results were obtained with a fuel temperature of 95 deg. Fah. at the pump, and the trials given above were all run at that temperature. As regards the mineral lubricating oil trials, the engine started readily from cold with this fuel, but was rather unsteady at the quarter load trial, requiring continuous hand adjustment. The exhaust was not clear on any of the trials run with this fuel, but it improved towards the completion of the six hours' full-load trial.

In the Mexican fuel trials it was found that, contrary to generally accepted practice, no advantage seemed to be obtained by heating the fuel, and it was, therefore, concluded that heating alone could not be considered the solution of effective burning in a small high-speed engine, and it was necessary to experiment with varying forms of nozzles. The type shown in Fig. 21 was found the most suitable in that it presented no surface in the immediate vicinity of the orifice to which the deposits could attach themselves and so form a nucleus of the growth which choked the sprayer in the ordinary design. By this means the full area of discharge has been found to be always preserved, but carbonisation on the sides of the piston at the top and sticking of the piston rings have not yet been satisfactorily overcome, and these matters are still being investigated. Particulars of the trials and of the fuels are shown in Table VI.

TABLE VI.—*"H" Class Engine. Results of Trials with Various Oils.*

Oil	B.P.M.	B.H.P.	Fuel in lb. per B.H.P./hr.
Shale	376	30.1	0.407
	341	22.4	0.406
	297	14.9	0.421
	237	7.5	0.466
Texas	375	30	0.426
	341	22.5	0.422
	299	15.1	0.446
	236	7.5	0.494
Palin	375	30	0.489
	345	22.7	0.482
	297	15	0.507
	240	7.6	0.577
Mineral lubricating ..	373	29.8	0.446
	343	22.6	0.427
	300	15.1	0.439
	235	7.5	0.517
Mexican	377	30.1	0.426
	342	22.5	0.421
	300	15.1	0.447
	245.5	7.8	0.575

Properties of the Above Oils.

	S.G. at 60° F.	Flash-point ° F.	Viscosity at 60° F. (50 c.c.).	Calorific value, B.Th.U. per lb.
			Secs.	
Shale	0.877	198	56	19,200
Texas	0.928	212	536	19,300
Mineral lubricating ..	0.884	378	876	19,948
Mexican	0.943	278	3,217	18,717

Palm oil—
- S.G. at 105° F. (liquid) 0.897
- S.G. at 60° F. (semi-solid) 0.923
- Melting-point .. .. 64° F.
- Flash-point .. .. 352° F.
- Viscosity at 110° F. .. .. 135 sec. (50 c.c.).
- Calorific value .. .. 16,700 B.Th.U.

VARIABLE LOAD TRIALS.

The Unit engine has been for some time reserved to investigate matters arising in connection with the submarine engines of the standard type. In particular, a series of trials has been carried out to determine the most suitable modifications to adapt surplus parts of this standard design for the construction of electric generating engines for other services. For these trials the engine was fitted with the standard submarine type cylinder cover, in which the spray valve is inclined at an angle of 26½ deg. to the vertical and fitted with the standard solid injection spray valve, fuel pump, scroll cam, &c. In one set of trials it was stipulated that the maximum power to be normally developed in the single cylinder was to be 50 brake horse-power at 300 revolutions per minute, with an overload of 55 brake horse-power to the same revolutions. It was desired that a range of powers from zero brake horse-power to the maximum could be obtained without alteration of the timing gear, and that the governing devices should operate the fuel pump suction valves. All tests were, therefore, made at a fixed timing gear set for 55 brake horse-power with a maximum combustion pressure of 630 lb. per square inch. The timings were:—

Air valve—	
Opens	20° B.T.C.
Closes	42° A.B.C.
Exhaust valve—	
Opens	124° A.T.C.
Closes	24° A.T.C.
Fuel valve—	
Opens	18° B.T.C., at 55 B.H.P.
Closes	8° A.T.C., at 55 B.H.P.

It was found necessary, however, to arrange for a slight movement of the fuel cut-out lever to restrict the lift and period of opening of the fuel valve. The movement necessary gave the timing of the fuel valve

* Read at the spring meetings of the sixty-fifth session of the Institution of Naval Architects, April 11th, 1924.

at no load as opening at 14 deg. B.T.C. and closing at 5 deg. A.T.C., the roller clearance changing from 0.004in. on load to 0.038in. at no load.

A smaller lift was found necessary and the fuel cam toe-piece had a rise of 0.09in. only as compared with 0.2in. on the standard engine.

Various sizes and numbers of holes in the spray nozzle of standard type were tried, but that found most suitable is shown in Fig. 22. This design, in association with the special toe-piece, gave good results when using either Texas or shale fuel oils, and eliminated the trouble due to "dribble" carbon that was experienced with

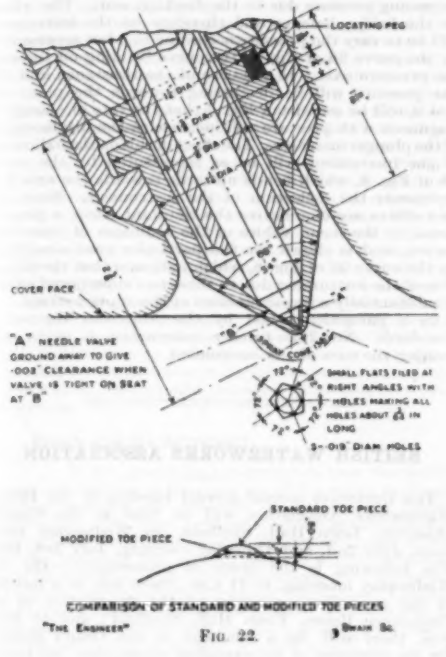

LOCATING PEG
COVER FACE
"A" NEEDLE VALVE GROUND AWAY TO GIVE ·003" CLEARANCE WHEN VALVE IS TIGHT ON SEAT AT "B"
SMALL FLATS FILED AT RIGHT ANGLES WITH HOLES MAKING ALL HOLES ABOUT ¼ IN LONG
3-·013" DIAM. HOLES
STANDARD TOE PIECE
MODIFIED TOE PIECE
COMPARISON OF STANDARD AND MODIFIED TOE PIECES
"THE ENGINEER"
BRAIN &c.

FIG. 22.

other types which permitted the trapping of fuel between the valve seat and spray orifices. A seven hours' test at no load with the engine running at 300 revolutions per minute was made, and no difficulty was experienced in carrying the 55 brake horse-power load immediately on the conclusion of the test.

To obtain the best results with a minimum of detonation it was necessary to adjust the compression to 480 lb. per square inch. The more satisfactory general behaviour and results with this compression as compared with 360 lb. per square inch can be seen from the results shown in Table VII. The colour of the exhaust varied from invisible to very slightly shaded throughout the trials.

TABLE VII.—*Unit Engine. Reduced Power Trials at 300 r.p.m.*

R.P.M.	B.H.P.	Fuel oil. Pressure. lb./sq. in.	Fuel oil. lb./hour.	Fuel oil. lb./B.H.P. hour.	Description.	Remarks.
301.5	55.5	4750	22.0	0.397	Texas. S.G. at 60° F. 0.928. Flash-point, 212° F.	Compression, 480 lb./sq. in. Maximum pressure, 630 lb./sq. in. Exhaust: Invisible to very slightly shaded
300.8	50.2	4500	20.06	0.400		
301.0	40.1	4750	16.62	0.415		
299.6	30.0	4750	13.53	0.451		
300.4	20.0	4500	10.69	0.535		
299.5	10.0	4500	7.37	0.738		
300.0	0	4500	6.44	—		
301.0	55.2	4750	21.5	0.390		Test run after zero trial
300.0	55.0	4720	23.25	0.423	As above	Compression, 360 lb./sq. in. Maximum pressure, 630 lb./sq. in. Exhaust: Invisible to slightly shaded. Detonation evident during all trials and the running was unsteady at the low powers
300.0	50.0	4500	20.59	0.412		
298.0	39.8	4500	17.2	0.432		
300.0	30.0	4500	13.13	0.438		
305.0	20.3	4500	10.94	0.54		
301.0	10.05	4500	8.44	0.839		
300.0	0	4500	6.34	—		
300.5	55.2	4000	21.36	0.387	Shale. S.G. at 60° F. 0.877. Flash-point, 196° F.	Compression, 480 lb./sq. in. Maximum pressure, 630 lb./sq. in. Exhaust: Invisible to very slightly shaded
299.2	49.9	4000	19.5	0.390		
302.8	40.3	4250	16.43	0.408		
303.5	30.4	4000	13.06	0.431		
302.4	20.15	4000	10.47	0.520		
302.2	10.09	4500	7.4	0.734		
298.5	0	4500	5.43	—		
300.0	55.0	4250	21.62	0.394		Test run after zero trial

The thanks of the writer are due to the staff of the Admiralty Engineering Laboratory for assistance in the preparation of the paper, particularly for the description of the experimental work.

International Shipping Conference.

No. II.*

LIFE SAVING AT SEA.

A SERIES of reports on life-saving appliances and wireless telegraphy was presented to the Conference.

When the subject was before the Shipping Conference in 1921 certain principles were laid down to form the basis of any further consideration of that part of the problem of safety of life at sea which relates to life-saving appliances. It was then pointed out that the safety of ships depended upon the care of the navigator and the type and design of the vessel rather than upon life-saving appliances, and that it was undesirable to formulate hard and fast rules for the design of buoyancy apparatus which would place obstacles in the way of naval architects and shipbuilders.

In connection with wireless telegraphy, it was insisted that if merchant ships were compelled to carry wireless, a free market in apparatus should be maintained. It was upon the Merchant Shipping Advisory Committee that the Government threw the burden of making recommendations in the light of recent experience, particularly in connection with boats and buoyancy apparatus, and the report laid before the Shipping Conference states that the Board of Trade is about to issue new instructions to its surveyors in accordance with the recommendations of that Committee.

The British progress report on wireless telegraphy points out that an international committee has examined the position, and suggested the advisability of calling a conference to consider the whole subject of wireless telegraphy. It is pointed out that the use of direction-finding apparatus is being steadily developed, and that proposals for the reorganisation and extension of the present system of giving bearings to vessels from coast stations are under consideration by the Government. It is believed that further facilities will be provided if sufficient support can be obtained from shipowners to warrant the necessary expenditure. The real line of progress is, it is suggested, the extended use on ships of direction finders by which a navigator can obtain cross bearings without asking for the aid of a shore station. The direction finder is now being fully tested on many ships, and is emerging from the experimental stage. When it comes into ordinary use as a navigational instrument, it will be necessary, states the report, for small sending stations in the form of wireless beacons to be set up.

The authorities of Trinity House who control the English lights have the whole subject under consideration, but in the meantime British shipowners have expressed the opinion that it would be unwise for any Government to make the fitting of direction finders compulsory. The existing facilities for broadcasting time and weather signals on the East Coast are said to be inadequate. Many of the ships requiring these signals are fitted with spark installations, and as the signals are being sent out on the continuous system, such vessels cannot receive them.

Reference is made in several of the reports to the urgent need of the adoption of an emergency call device. As long since as May, 1922, an instrument of the kind required having an 80 per cent. efficiency had been evolved, and it is hoped that the further tests which are now being carried out by the British Government will lead to approval being given to one of the existing devices.

In the French report it is stated that an automatic selector for distress signals has in recent experiments given complete satisfaction, and steps are being taken at the present time to secure its adoption by the French Government.

At the final session of the Conference on Friday last, it was suggested that a fresh diplomatic conference to review the conditions under which wireless telegraphy could be used for life-saving purposes at sea to the best advantage should be convened. The possible bases for a new convention on the subject have been discussed, but the Committee which has had the matter in hand is not prepared to make any recommendations on the subject.

BRITISH PORT FACILITIES.

The detailed report of the Committee of the Chamber of Shipping, which, following the criticisms of continental shipowners, has made an inspection of twenty-seven ports, was not laid before the Conference, but Sir Frederick Lewis, the chairman of the Committee, made a statement which brought out a number of interesting facts. The ports visited included those of London, Liverpool, Glasgow, Southampton, Manchester, the Bristol Channel, Hull, Immingham, and the North-East Coast generally, Dundee, Leith, Methil and Grangemouth.

Sir Frederick said that while the criticisms were to some extent justified, those making the complaints had not been fully informed of particular circumstances connected with the conditions of the ports or with the difficulties which had confronted British port authorities. The visiting Committee had found in a majority of instances that port authorities were fully alive to the necessity of development schemes being undertaken. It had to be remembered that four years of war and five years of difficult post-war conditions had been more detrimental to British than to northern European ports generally. During that period proper maintenance, altogether apart from development, was impossible. In the year 1923, when exports of British coal rose to 79¼ million tons, or 6 million tons in excess of the pre-war figure, the strain on the facilities of ports dealing with such cargoes was very great, and was accentuated by the fact that there was a strike of dockers and that working hours had been reduced. Improvement schemes were now, however, receiving attention. Work, involving a capital expenditure of about £20,000,000, was already in hand, and it was probable that a much larger amount would be expended in the near future. New docks were either being built or had been authorised; new coal staithes and coal-shipping appliances were being constructed at some of the North-East Coast and South Wales ports. The Great Western Railway had commenced to carry out a general improvement scheme at the Bristol Channel docks, and at other ports improvement schemes were in hand which would lead, the Committee was convinced, to greater despatch in loading and discharging cargo at British ports.

Mr. D. Hudig, one of the Dutch delegates, said that continental shipowners were not yet satisfied with the facilities provided at certain British ports, but that he hoped that the better prospects held out by Sir Frederick Lewis would materialise. He was bound to state, however, that the coal-shipping facilities at the greater number of British ports were inadequate for present-day requirements.

The Conference passed a resolution to the effect that the bodies represented at the Conference should be asked to do all in their power to secure that port facilities kept pace with the requirements of trade.

* No. I. appeared May 16th.

A New Electrical Telemeter.

WORK has been in progress for several years at the American Bureau of Standards on an electrical device for the measurements of strains, forces, displacements and accelerations with a view to making an instrument that would give readings and records at a distance and at the same time be suitable for the measurements of quantities that are rapidly varying in value. A new electric telemeter has been designed, which depends upon the displacement resistance characteristic or corresponding pressure resistance characteristic of a stack of carbon plates, and means of mounting these stacks have been devised which enable accurate calibration to be made and which give sufficient stability to enable the stacks to withstand the shocks due to ordinary handling. Practical applications so far made consist of (1) measurement of loads in airplane stay cables during flight, (2) measurement of strains in airship girders during construction, (3) tests of bridge members subjected to live loading, (4) tests of airship girders and bridge members in the laboratory, (5) measurement of pull on the arm of a dynamometer, and (6) measurement of pressure. The chief advantages claimed for the instrument are that simultaneous records or readings can be made of strains, forces, and pressures occurring at a number of widely separated points, and that rapidly varying values can be photographically recorded in their true proportions. Measurements can also be made in places which are inaccessible during the tests.

The operation of the instrument depends upon the well-known fact that if a stack of carbon plates be held under pressure a change of pressure will be accompanied by a change of electrical resistance, and also a change in the length of the stack, both of which are reversible, the stack of plates under a change of pressure behaving like an elastic body. If suitable terminal pieces or mountings of the stack of plates be attached to a structural member at two points spaced some distance apart, the application of stress in the direction of the line joining the terminal pieces will change the length of the stack and also the electrical resistance on account of the change of pressure. It thus becomes possible with proper arrangements to obtain an indication of the amount of strain in the structural member, and in all cases where stress is proportional to strain to establish a definite relation between stress and the electrical resistance of the carbon stack. This resistance can readily be measured at any convenient point by running wires from the terminals of the carbon resistance to a suitable measuring instrument. Means have been devised for calibrating the measuring instrument directly in terms of strain or force. The idea of utilising the displacement resistance characteristic or the correlated pressure resistance of a stack of carbon plates for making engineering measurements is not new. Numerous measurements have been made in this way in the past, but on account of hysteresis effects and the non-linear character and instability of the calibration the accuracy obtained was low.

The elementary principle on which the new telemeter operates will be gathered from Fig. 1; 1 is a portion of the structural element in which the strain is to be measured, 2 and 3 are terminal blocks rigidly attached to the structural element, and 4 is a series of carbon discs under pressure, the resistance of the discs varying if the pressure is changed. If the member 1 be subjected to stress either of tension or compression there will be a relative displacement of the terminals 2 and 3, which will give rise to a change in the pressure exerted by the plunger 5 on the resistance element 4, resulting in changes in resistance of the latter. If the apparatus is properly constructed these resistance changes will bear a definite relation to the strain in the member under test, and will therefore afford a measure of the strain from which the stress can be determined.

The diagram Fig. 2 shows an arrangement which enables the strain in a test piece to be read directly on an indicating instrument at any convenient point. The displacement resistance device 4 is placed in one arm of a Wheatstone bridge, the three other arms of which being indicated at 6, 7, and 8. The instrument 9 may be a milliammeter or oscillograph element, which serves to indicate the extent of any unbalance in the bridge circuit. The battery 10 energises the bridge circuit and the current is regulated

by the variable resistance 11. The resistances 6, 7, and 8 are adjusted so that the bridge is balanced when the stress to be determined is zero, and the instrument 9 then gives no deflection. When, however, the test member is placed under stress the changes in the resistance of the resistance of the pile 4 destroys the balance of the bridge and the extent of the out of balance, and therefore the strain is indicated by the bridging instrument 9, which may be calibrated to give a direct reading of the strain.

The value of the resistances hitherto used have varied from time to time, and the sensitivity or changes of resistance for a given change of pressure have also varied. A careful study of the cause of this instability has been made, and it has been found that if two or more pieces of carbon be placed in contact and if they be subjected to a certain pressure there will be a definite relationship between the resistance and the pressure as long as the points at which contact between the separate pieces occur remain absolutely the same. Changes in the number and position of the contact areas may occur if the contact areas are stressed beyond the elastic limit, resulting in crushing. They may also occur if the slightest move is made in a tangential direction between two adjacent surfaces in contact, and even if the tangential displacement be very small there will be large changes in resistance. The reason these devices have proved erratic in the past is that the construction has either permitted slight lateral displacements or at times the pressures have been sufficient to cause crushing at the contact surfaces. The contacts should be ground flat to give a relatively large area to the

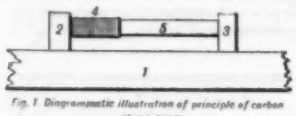


Fig. 1. Diagrammatic illustration of principle of carbon strain gauge

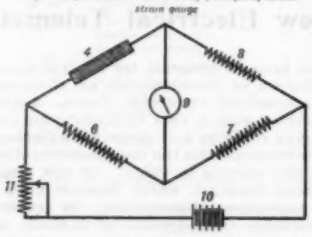


Fig. 2. Diagram showing principle of connecting single element resistor in Wheatstone bridge.

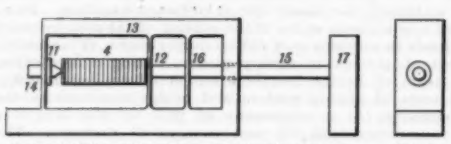


Fig. 3. Method of mounting single element resistance for strain gauge (side view).

Fig. 4. End view

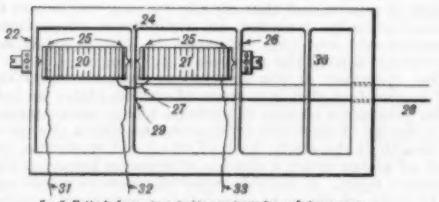


Fig. 5. Method of mounting double-resistance type of strain gauge.

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actual surfaces, and the carbon plates should be mounted so that it is impossible to set up a shearing force across the contact surface. The apparatus must also be constructed so that under normal conditions variations of pressure will be insufficient to give rise to a permanent change of conditions at the contact surfaces.

Apparatus constructed in the past for strain gauge measurements have also proved inaccurate on account of hysteresis effects. These effects, it has been found, were due to mechanical friction in the mountings and at the terminals used to connect the carbon resistances to the member under test, and if these terminals are properly designed so as to eliminate mechanical friction the hysteresis effect is removed. The scheme adopted for overcoming the difficulties is shown in Figs. 3 and 4. The displacement resistance device 4 consists of carbon discs in contact with one another and pressed between two stiff plates or diaphragms 11 and 12, the plates being fixed at their outer extremities to the frame 13, and a set screw 14 is provided for adjusting the initial pressure on the discs. If the discs are held together under considerable pressure the tendency for transverse displacement to occur is greatly reduced. On the other hand, the higher the pressure on the discs the smaller will be the sensitivity to variations of pressure, and care must be taken not to make this initial pressure too high, otherwise the sensitivity will become too low for practical purposes. Moreover, the initial pressure must be kept well below the elastic limit of the carbon discs at the point of contact; but at the same time it is desirable to make this initial pressure as high as these two considerations will permit.

A plunger 15 is connected at one end of the plate 12, and it passes through a third plate 16, and is firmly connected to it. The enclosing frame 13 may constitute one of the terminal pieces corresponding to 2 in Fig. 1, and which is rigidly connected to the number under test. The plunger 15 is extended to the other terminal 17, which corresponds to 3 in Fig. 1, and may be simply a solid terminal piece or may be made up exactly like the part just described. When used for mounting both the displacement resistance device and the plunger 15, this plate arrangement accomplishes two purposes. As the plunger is entirely supported by the plates 12 and 16, the small displacement necessary in an axial direction is permitted by a slight warping of the plate, and all sliding contacts and hysteresis effects are eliminated. Moreover, the rigidity of the plates in all directions, except parallel to the axis of the plunger, is so great that the tangential motion of the contact surfaces of the displacement resistance device 4 relatively to each other is prevented, and consequently permanent changes of resistance do not occur. In normal operation the plunger 15 is connected to the two terminals, 13 and 17, which are rigidly connected in turn with the member under test, and when the member is subjected to stress there will be a slight movement of the plunger. If the

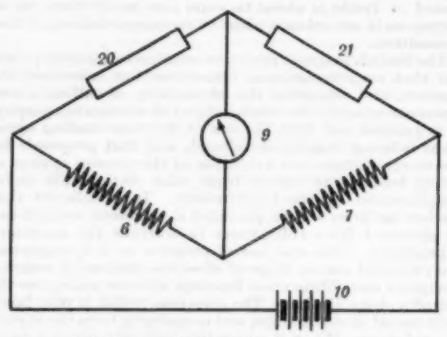

Fig. 6 Diagram showing connection of the two elements of strain gauge in Wheatstone bridge.

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plate 11 is made too rigid in the direction of this displacement there will be very great variations in the pressure on the displacement resistance device 4, and if this displacement is too great it will give rise to permanent changes in the resistance. In order to prevent this the parts 11 and 12 are made to yield so that the small displacement to which the plunger is subjected in use will give rise to a variation of pressure on the displacement resistance device 4, which is small in comparison with the initial pressure permanently applied to it.

Another difficulty that has hitherto been experienced in the development of instruments of this kind is that the resistance of a series of carbon contacts is not a linear function of the displacement of the terminals or the pressure applied thereto, but an arrangement has been devised which overcomes this difficulty and which causes the apparatus to give strictly linear indications of the stress and strain. The principle involved will be understood from Fig. 5. A resistance unit 20, made up of conductors, preferably consisting of annular rings placed in contact with one another, is placed between the plates 22 and 24, and another unit 21 between the plates 24 and 26, the two units being insulated by bushings 25. These two units are connected together electrically by the wire 27. A plunger 28 is connected near the centre of the plate 24 at the point 29, and it extends to and beyond the plate 30, to which it is also firmly fixed. The plunger then extends on to the other terminal of the apparatus, as in the case shown in Fig. 3. If the leads 31, 32 and 33 are brought out to any convenient point at which it is desired to place the indicating instrument, it is evident that the two resistances 20 and 21 can be connected in the two arms of a Wheatstone bridge, as shown in Fig. 6. The bridge may be balanced by adjusting the relative resistance of the two remaining arms 6 and 7 of the bridge, and it will be seen that if a displacement occurs on the plunger 28 of Fig. 5 in an axial direction, the pressure on one of the units will be increased and that on the other decreased, and both these effects will tend to upset the balance of the bridge and produce a deflection on the indicating instrument 9.

By this arrangement two important advantages are obtained. In the first place the effects of displacement on the two resistance units is cumulative so far as disturbing the balance of the bridge is concerned, and consequently a given effect on the indicating instrument can be secured by so designing the apparatus as to use only half as much displacement on each unit as would be necessary if only one unit were employed. Since the relation between the resistance of the units and the displacement applied to them is represented by a curved line, the greater the displacement range the greater will be the departure from a straight line. Hence by reducing by one half the amount of change required for a given effect on the instrument a much closer approximation to the desired linear relationship is obtained.

The second important advantage of the form of construction described contributes still more to the establishment of a linear relationship. A typical characteristic curve of the contact resistance device is given in Fig. 7. When the pressure is small the curve is very steep, and small changes of pressure give rise to relative large changes of resistance, but as the pressure increases the rate of change of resistance steadily decreases. Let us now consider what happens in the case of two resistance units as shown in 5 and 6. When the plunger 28 is not subjected to any displacement, the two units are under the same pressure, which may be assumed to correspond to the point 34 of Fig. 7. But if the plunger 28 be gradually displaced in a direction which increases, the pressure on the resistance unit 20, towards the point 35, the rate of change of the resistance with displacement will have a certain value at the start, but will gradually fall off with increasing pressure due to the displacement. The effect on the bridge balance and therefore on the instrument will be to vary the pressure according to a law represented by the curve 36 of Fig. 8, the curve bending off towards the pressure axis. In the case of the resistance unit 21, the pressure will be decreasing towards the point 37, and it will be seen from Fig. 7 that the rate of change of resistance with pressure will increase as the displacement of the plunger increases. The effect of this on the indication of the instrument will be as represented by the curve 38 of Fig. 8, which bends upwards towards the axis and represents the deflection of the instrument. Since the two effects are cumulative the resultant effect is proportional to the mean values of the ordinates of these two curves, and is shown for the particular case considered by the curve 39 of Fig. 8, which indicates that the deflection of the instrument due to these two superposed effects is substantially a linear function of the applied stress.

In a pamphlet issued by the American Bureau of Standards—No. 247—further information is given concerning the uses of the instrument.

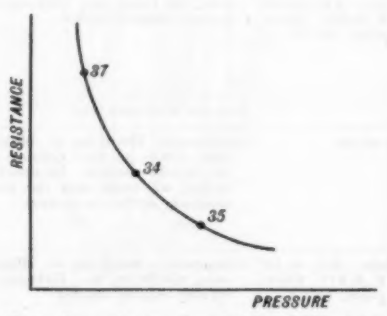

Fig. 7. Curve showing characteristic relations between resistance and pressure of single stack of carbon plates.

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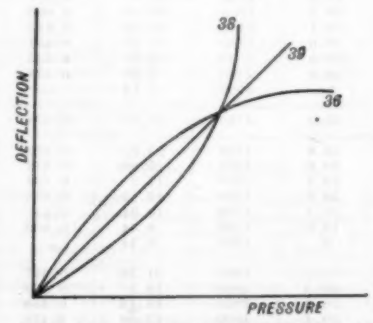

Fig. 8. Curve showing the curved characteristics of two stacks of plates.

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BRITISH WATERWORKS ASSOCIATION.

THE thirteenth annual general meeting of the British Waterworks Association will be held in the Council Chamber, Town Hall, Sheffield, on Wednesday afternoon, July 2nd, and Thursday morning, July 3rd, 1924. The following is the order of proceedings:—On the Wednesday morning, at 11 a.m., there will be a meeting of the executive committee of the Association in the Conference Room, Town Hall, Sheffield; and at 12.45 p.m. there will be a luncheon at the Grand Hotel—for the members of the executive committee—by invitation of Alderman W. Carter Fenton. In the afternoon, at 2.15 p.m., the members will be welcomed by the Lord Mayor in the Council Chamber, and after the transaction of the usual business the new president will be elected and installed and will deliver his presidential address. At 3.15 p.m. Dr. I. G. Gibbon, assistant secretary, Ministry of Health, will open a discussion on "The Need for Establishing Regional Water Committees." In the evening, at 7 p.m., there will be a reception at the Grand Hotel by Alderman W. Carter Fenton, F.R.I.B.A., and at 7.30 p.m. the annual dinner will be held at the Grand Hotel.

On the Thursday morning, at 10 a.m., the following papers will be read and discussed:—"The Purification of Water Supplies," by Sir Alexander Houston, director of water examination to the Metropolitan Water Board; "Conservation of Sources of Water Supply," by Mr. Joseph Parry, M. Inst. C.E., late engineer-in-chief to the Liverpool Corporation Waterworks; "Protection of Underground Water Supplies," by Mr. A. B. Cathcart, M. Inst. C.E., waterworks engineer to the Brighton Corporation. At 1 p.m. luncheon will be taken at the Town Hall by invitation of the Lord Mayor. In the afternoon a visit will be paid to the Little Don Valley Reservoirs, and to the Ewden Valley reservoirs and works in course of construction. On Friday, July 4th, a visit will be paid to the River Don Pumping Works, Loxley Valley Reservoirs, and the reservoirs of Derwent Valley Water Board. For the Saturday, alternative visits have been arranged to (*a*) Staveley Coal and Iron Company, Limited, Staveley; (*b*) Guest and Chrimes, Limited, Rotherham; (*c*) the sewage disposal works to see the bio-aeration system by mechanical agitation in operation; (*d*) Steel, Peech and Tozer, Limited, Phœnix Works; (*e*) cutlery and silver-plate manufacturers, Joseph Rodgers and Sons, and Walker and Hall, Limited; and (*f*) the Mappin Art Gallery and Museum.

AN International Exhibition is to be held in Dunedin, New Zealand, opening about November 12th, 1925. The New Zealand Government has given its patronage to the project, and is also assisting it financially.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

General Situation.

UNSETTLED market conditions continue in the Midlands and Staffordshire. The uncertainty produced by political changes on the Continent has in some degree further checked business, owing to possible effects upon currency values and foreign coke demands. For the time being there is very little new business being placed, either with home or continental makers of iron and steel. The question of fuel prices is one of considerable importance, and both producers and consumers have been awaiting the outcome of the negotiations between Midland blast-furnacemen and coke suppliers. Some satisfaction is expressed that iron and steel had their share in the expansion of external trade during April, the figure having risen from 288,152 tons, value £5,936,592, in March to 336,799 tons, value £6,368,495. It is conspicuous that again during the month an increased proportion of our supplies of iron and steel came from abroad. Since last autumn the tide has been rapidly rising, until last month imports of iron and steel and manufactures thereof aggregated no less than the remarkable total of 198,902 tons. We should have to search a long way back to find a parallel to this figure. In March the tonnage was 165,152. Last year our imports averaged 110,000 tons per month; in 1922 the average was not much more than 73,000 tons; and in 1921 it was 133,000 tons. Some consolation is gained from the knowledge that if we bought more largely from abroad we also sold increased quantities to overseas customers.

Miners and the Agreement.

It is a gratifying circumstance that the developments in relation to the question of the wages in the coal mining industry are distinctly in favour of a peaceful settlement. The new proposals, which are substantially better than those contained in the owners' offer rejected by the ballot of last month, and are a very substantial gain for the men on the 1921 agreement, are considered to be acceptable to miners in most of the Midland coalfields. The owners' last offer, it will be recalled, was by a majority recommended for rejection by the Executive, yet, despite this the actual ballot showed as many as 322,392 votes for acceptance and only 338,650 for rejection. In the circumstances, it is reasonable to hope that the new proposals, substantially better and recommended by the Executive, will be accepted by both the delegates' conference on May 29th and by the men. Industrialists in the Midlands and Staffordshire accordingly take a more hopeful view of the industrial situation, for unless fuel values are settled, values of materials are bound to fluctuate, but with some stability in fuel values, there is a reasonable chance of more regular and settled prices in the iron and steel market.

The Fuel Question.

The conference of coke makers and furnacemen held last week to review coke prices, to which I referred in my last letter, unfortunately yielded no result, and the meeting was adjourned for further consideration of the matter. Pending the issue, buying and selling are very quiet indeed, orders being few in number and small in size. Makers of pig iron who at the conference pressed for a reduction in coke prices, think the position has been so changed by the falling off in exports that they should be able to buy their coke at something less than 24s. at the ovens that has applied to contracts for Midland blast-furnaces since the autumn. In the North of England the pig iron makers are now able to buy coke at £1 8s. 6d. delivered. When the cost of transport is added to the £1 4s. for Yorkshire coke, the Midland maker is about 4s. per ton worse off than the Cleveland furnaceman, and his competitive ability is consequently considerably impaired. Coke makers, who at the conference demanded an increase, protest that as miners' wages will inevitably be higher they are entitled to 25s. And so new contracts are in suspense. On the open market there are offers of supplies at 24s. Furnace owners are buying cautiously at this price. The strike of Ruhr miners adds to the uncertainty of the outcome.

Pig Iron.

In the pig iron department there is a decided lull, which is partly due to uncertainty as to fuel prices. The demand is so small that producers have lately been obliged to place some of their product in stock. Consumers of pig iron are holding off the market. They calculate that if coke prices fall as the result of the negotiations now in progress, something will come off the cost of pig iron. If coke rises—which few people consider a likely contingency—the inertness of the market will be a sufficient safeguard against any addition to pig iron prices, unremunerative though they are. So the outlook for the furnacemen is not hopeful in either case. For the present, pig iron prices are moderately firm, Derbyshire and North Staffordshire being quoted at £4 15s. for foundry iron and Northampton £4 12s. 6d. Derbyshire and North Staffordshire forge irons are quoted £4 7s. 6d., and Northamptonshire makes £4 5s. to £4 6s. The needs of the engineering industry are expanding a little, but the production is more than sufficient to meet current requirements. Fairly good contracts were placed for forge iron some weeks ago, but in some cases deliveries have been suspended, owing to the slow rate of consumption by Staffordshire forges of this raw material. There was a marked drop in pig iron output last month. Statistics show that production in April amounted to no more than 618,400 tons, as compared with 668,600 tons in March and 652,200 tons in April, 1923. This despite the fact that the number of furnaces in blast remained the same as at the end of March, viz., 194. The production, it is interesting to note, included 188,400 tons of hematite, 221,400 tons of basic, 145,800 tons of foundry, and 33,700 tons of forge pig iron. Of this production, we exported no less than 48,758 tons, which was a big advance on the previous month when the exports amounted to 28,327 tons. All the principal European countries increased their purchases. Germany took 6506 tons as compared with 1310 in March, and Belgium 14,753 tons against 7584 tons the previous month, nearly double the quantity. Unfortunately, though our exports increased so did our imports. We imported 19,630 tons of basic pig, as compared with 11,956 tons in March. Belgium supplied 5310 tons, against 3379 tons; France, 7073 tons, against 6959 tons. Imports of forge and foundry pig aggregated 11,449 tons, against 10,700 tons. Belgium's share was smaller than in the previous month, but it amounted to 8451 tons; whilst shipments from Sweden ran almost into four figures.

Steel.

There is little change in the finished steel situation. Prices are, if anything, slightly weaker, owing to increased keenness by steel makers for new business, and small bars and gas strip lately quoted at £10 15s. are now £10 10s., though this is said to be a firm figure. Angles and joists make £9 17s. 6d. to £10, and tees £10 17s. 6d. to £11. Ship, bridge and tank plates command £10 10s., and boiler plates £14. Staffordshire hoops are quoted £12 at works. Under a revision of the British standard list of extras for bar iron, a special price will now apply to ½in. round and also to flats, ¾in. by ¼in. Some minor adjustments have been effected in prices of finished wire, but the general basis is unchanged. Very little new business has been given out, but a hopeful feature is the gradual expansion of shipbuilding demands, the shipyards having a good deal of repair work on hand. Building requirements also tend to expansion. There is a good balance of railway contracts yet to be disposed of. Tonnages now tend to become smaller in individual contracts, owing to the prevailing impression that steel may become cheaper. The steel works are finding it impossible to make full time, although they are moderately supplied with work. The market is rather firmer for billets, and though they can be bought at £8, some large producers claim to be getting £8 5s. and even more. Continental producers are again competing for the market, and have considerably reduced their quotations. Belgian billets are offered at £7 2s. 6d. for July and August delivery, as against the current price of £7 10s. Offers brought out a limited amount of speculation, for £7 5s. is a figure at which English re-rollers are prepared to buy. The statistics of output for April show that the output of steel ingots and castings amounted to 711,500 tons, which is a decrease of 105,400 tons compared with March, and a decrease compared with April, 1923, when the output amounted to 749,400 tons. A substantial part of our steel exports last month consisted of bars, rods, angles, shapes, and sections. There was a gain of nearly 7000 tons in railway material, &c., and minor improvements were shown in steel exported, girders, beams, joists and pillars, hoops and strips, black plates, cast tubes, pipes and fittings, wire and wire manufactures, and some others. On the import side, it is noted that Belgium and France supplied us with the greater part of the 63,525 tons of steel billets, blooms and slabs bought from outside sources. The March total was 48,530 tons. Belgium sent over big tonnages of bars, rods, angles and sections, the imports under these heads showing substantial increases. The shipments of steel girders, beams, joists, and pillars from Belgium were doubled. Imports of hoops and strips, plates and sheets, wire and wire manufactures diminished.

Scrap.

The weakness in the scrap department continues, and values do not tend to improve. A good deal of wrought iron scrap continues to be offered, but demand is sluggish. There is a poor call also for steel scrap, chiefly on account of the heavy consignments from the Continent, most of which are bought by Welsh steel works at prices well below English quotations.

Rolling Stock Business.

The rolling stock establishments in Birmingham and the Black Country section of the Midlands continue to be steadily engaged, but they have taken hardly any contracts of moment within recent weeks. Deliveries are being made to India, South Africa, and South America. Outstanding work for overseas customers, coupled with the orders received from the home railways and from collieries and other private traders, will provide employment for some months to come. It is hoped that in the meantime new business will be negotiated, but at present there are no large contracts in view. Considerable amounts of bridge-building material and other plant are being sent from the Midlands to South Africa, in addition to the trucks and passenger coaches that are leaving the rolling stock establishments.

Manufactured Iron.

The situation in the Staffordshire manufactured iron trade remains substantially as last week. The brightest department is that of marked bars, which still sell freely at £15 per ton. For medium bars, makers obtain £13 to £13 5s. Nut and bolt iron continues to be quoted £12. Belgian nut and bolt iron has been offered this week at more than £3 below Staffordshire makers' prices. In spite of the low price, very little foreign iron is being bought, chiefly because, in the present state of uncertainty, nut and bolt makers prefer to obtain delivery of the foreign orders in arrears before ordering new material. It is interesting to note as affecting the demand for bar iron, that some recovery took place last month in the exports of bolts and nuts, though the tonnage was below that exported in February last. Exports of anchors, grapnels, chain cables and chains were better, the total being 1837 tons, against 1195 tons.

Galvanised Sheets.

In spite of the heavy exports of galvanised sheets during the month of April—they were 9000 tons more than in the previous month—and the fact that there are still good reserves of orders to be disposed of, sheet values continue weak. Galvanised corrugated sheets of 24 gauge are obtainable at £17 per ton at works or f.o.b. for export, though a few mills who are well situated quote up to £17 10s. Prices of black sheets remain firm, though the demand shows a slight falling off, owing to the curtailment of production at some of the motor engineering establishments.

Unemployment Figures.

Though the unemployment figures for the Midlands area again this week show on the whole a steady decline, in many of the large towns increases are recorded. The present total of 120,043 is 792 less than last week. The Birmingham figure of 30,658 shows a decrease of 255. At Coventry, however, the figure 1949 shows that unemployment has there increased by 223 persons. Increases are also reported from:—Bilston, 11; Cradley Heath, 63; Stourbridge and Brierley Hill, 10; West Bromwich, 111; and Wolverhampton, 48. Decreases have taken place at:—Dudley, 171; Oldbury, 10; Smethwick, 32; and Walsall, 253. There are now in the Midland area:—86,657 men without employment, 1740 boys, 28,694 women, and 2952 girls.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Outlook.

IN the markets here for iron and metals there is at present no indication of coming improvement, although public men seem to be very anxious to find it, and, judging from political speeches, one might easily imagine that a revival in trade was in sight. With people actually engaged in the business of the district, however, there is no such optimism, and those who are apt to take the most cheerful view here do not look for any serious change for the better before the autumn of the present year. That there is a slow recovery in German industrial life is generally admitted, and the demand from Germany for certain classes of raw material has been larger, and would have been much better had it not been for the disastrous currency speculations. This German revival, however, if it progresses, will affect our copper and tin markets more than the iron and steel markets. The relief from anxiety as to a coal strike this year is something to the good, although it may not be what is called a "bull point" for the iron and steel trades.

Metals.

The market for copper has not yet taken a decided turn for the better, but one begins to suspect that this cannot now be very far off. The prices in the copper market have fallen steadily since March, and the highest prices in March and the lowest prices in May show a difference of £8 per ton in standard. The reduction in sheets and rods during that time is £6 per ton, but that in tubes only about £3 to £4 per ton. Just at present we are regaled with tales from America as to the rapid falling off of the domestic consumption of copper, but one is inclined to think that there is some exaggeration here. Of course, at this time of year there is usually some slackening in American consumption, but there has been at the same time a contraction of the output and a very good export trade. In fact, the figures for the first three months of the year show that the exports of copper from America have been largely in excess of last year. On the whole, the statistics of copper are favourable, and at the same time the prices are low. One notices a growing disposition to take a more optimistic view of this market, and those consumers who have work in hand which will require copper during the remainder of the year cannot be taking much risk if they arrange their contracts now. If any serious move in such a direction should occur it would mean that visible stocks of copper would be distributed and would become at once invisible stocks, and the statistical position would soon show much more favourably. The scrap metals still remain very cheap here, and dealers have reduced their buying prices in view of the fact that selling is so difficult. There is a plethora of old gun-metal about at very low prices; but on the other hand, first-class scrap copper, such as fire-box plates or even locomotive tubes cut up, is scarce. Dealers here are offering only £46 at most for good gun-metal scrap, and the engineer who is in a position to use such material ought to be able to obtain supplies at very moderate rates. The general position in the tin market remains extremely uncertain. There are many people here who think that £200 will be reached before the slump is over, and, of course, there is nothing in the nature of things to prevent the fall from going even beyond that limit. Sellers, on the other hand, point out that a fall of £80 per ton in the course of two months ought to lead to a reaction; but then tin is an incalculable metal. Lead has been a steadier market and confidence in the present level of prices is beginning to return. There is only a small demand here, but that is not an unusual feature at this time of year. Much depends upon whether or not the American consumptive demand will revive. Sheet and pipe prices are too high in proportion. Spelter has remained a very quiet market for the last week or two, and in this district one hears of very little demand.

Pig Iron.

There is now only a very restricted market here for foundry iron, and apparently a good many of the usual buyers are holding back under the impression that prices must come down next quarter, if not before. They are encouraged in this belief by the easier tendency of furnace coke, and that at a time when it is being arranged to pay higher wages to the colliers. There has, of course, been a kind of slump in coal prices in Derbyshire and Yorkshire and partially in Lancashire; but this is the natural result of the excessive buying which took place in March and April under the conviction that a coal stoppage was bound to come. Consumers are now using up these extra stocks, and the market is, of course, devoid of orders; but it does not quite follow that furnace coke will be much

cheaper, and sellers of pig iron are positive that they cannot reduce prices under present costs. In the absence of much activity in the demand for castings in this district it is probable that most ironfounders have sufficient pig iron to keep them going yet for some time, and in all likelihood there will not be much need for fresh purchases before the end of June. Whether sellers can also hold out until then remains to be seen, but there is not much pressure to sell yet. In one or two cases one hears of Derbyshire No. 3 being offered at a basis of 93s. 6d., and in many cases 94s. at the furnaces would now be accepted. This makes the Manchester price 101s. to 101s. 6d. per ton delivered. Northamptonshire and Lincolnshire irons are offered at much the same price, but there is not any very large quantity available for this neighbourhood. Scotch iron remains steady here, and makers are basing their prices on 100s. to 102s. 6d. at the furnaces. The rate is now about 16s. 6d. per ton by rail, and it is doubtful whether much, if any, advantage is to be gained by sending by water. Nevertheless, there are, or have been, recently sales by merchants at below the lowest makers' price.

Steel.

The position in the finished steel trade seems a little weaker. At any rate, it is fairly easy now to buy joists and angles at £9 10s. in the Manchester district, whereas from £9 12s. 6d. to £9 15s. was formerly quoted. The prices for common plates vary a good deal, but Scottish makers seem more eager to get orders. Plates can be bought at £10 per ton, although there is at least one firm which holds out for £10 15s. Boiler plates are still quoted at £13 10s., but one would think that some concession on this price ought to be obtainable. Flat bar steel is at £10 to £10 2s. 6d., and round bars at £10 5s. to £10 15s. The demand for manufactured iron, although not good, is better than that for steel.

Scrap.

The market for steel scrap is rather lifeless again, and apparently it is now difficult to obtain orders from the Sheffield consumers. Dealers here talk of 75s. per ton on trucks in Lancashire, but that is a price which some of them are prepared to pay. Heavy wrought scrap is still in good demand and apparently the ironworks are not getting all that they want. From 105s. to 110s. per ton is roughly what they are offering for delivery at the works. Foundry scrap, on the other hand, is rather too plentiful, and the demand for it is weak, although dealers still quote from 87s. 6d. to 92s. 6d. per ton, delivered free to the foundries.

The Engineering Trades.

It cannot unfortunately be said that the outlook of the engineering industry in this part of the country shows any tendency towards improvement, nor is there any likelihood of its so doing while the conditions of the labour market remain so obscure. The position of the industry is very clearly shown by Sir Allan Smith's survey at the conference of the fifty-two trade unions and representatives of the Engineering and National Employers' Federation last week. In his statement Sir Allan showed beyond any shadow of doubt that the position of 1020 firms, representing 65 per cent. of the employing power of the Federation was materially worse at the present time than it was twelve months ago. The state of the industry has been ascertained by confidential returns, supplied by the firms themselves, from which it appears that when the forms were filled in on April 1st the value of the work on the order books amounted to only £65,540,591, compared with £149,332,031 last year. The tremendous falling off applies to both home and foreign orders. If figures such as these represent the average state of trade in the engineering world at the present time, it will require more than all the argumentative powers of the trade union leaders to convince public opinion that the time is ripe for increasing wages from 10s. to £1 per week. Of the £65,540,591 worth of work on the order books, materials represented £30,000,000, direct wages about £13,000,000, indirect wages just over £9,000,000, charges just over £13,000,000, and administration charges 1½ per cent., leaving an available credit balance of 0.3 per cent. to pay capital charges, income tax and provide capital for working. The branches of engineering manufacture in this district that are still under a cloud are those devoted to steam engine building, constructional work, textile machinery, and machine tools. Locomotive builders are fairly well employed at present, although many orders have been booked at unremunerative prices. Several firms which supply motor car parts are said to have had orders cut down recently owing to the decision of Parliament to withdraw the McKenna duties on imported cars.

BARROW-IN-FURNESS.

Hematite.

There is a better report to make of the hematite pig iron trade, but one is inclined to be careful when speaking of the future. At present the amount of iron which is being made is very small, comparatively speaking, but the business which is being done is being the means of gradually reducing the stock which makers are holding. In some cases where the ironworks are closed, and they were closed owing to accumulated stocks due to a stoppage in the steel departments as well as a slump in business, the stocks are gradually being cleared. In such cases as these the resumption of production will largely depend upon business done in the meantime, and it is safe to say that there is little likelihood of there being any increase in the amount of production until after Whitsuntide. Cumberland will take more iron as a result of the steel departments re-starting. There is just a glimmer of hope in the fact that the number of inquiries is increasing. This is quite natural, as has been pointed out in previous letters. It is well known that customers are coming into the market, and as soon as there is peace in the coal trade, and other trades affecting the iron trade, there will be much more life.

Iron Ore.

The iron ore trade is dull in consequence of the restrictions in output in the iron trade, and until there is an improvement there will be little done. The Hodbarrow mines, which have been partially working, have stopped again, and this is a very true reflection of the state of trade. The trade in foreign ore is not large, naturally, nor is it likely to be yet awhile.

Steel.

There is not much business being done in steel, and the competition for such orders as are in the market is keen. The Barrow rail and merchant mills are still idle, and likely to be for some time yet. The rail mills at Workington have orders which will keep them engaged for a few weeks. The only steel departments which are engaged at Barrow are the hoop and small section mills, which are much better situated for orders.

SHEFFIELD.

(From our own Correspondent.)

Profitless Steel Production.

THERE is nothing very cheering to report about the state of the steel industries, particularly the armament and other heavy branches. The great works go on producing large quantities of material, but they are not fully employed, and a very unsatisfactory feature is that many of the orders are taken at low prices which yield no profit, and in some cases actually result in a loss. It is becoming increasingly evident that, so far from the lean times coming to an end, the past year has been one of the worst since the slump set in. The great firm of Cammell Laird and Co. was unable to pay a dividend for 1923. Hadfields, Limited, could only pay 4 per cent., less tax. A few days ago came the news that Vickers Limited had decided to pass its ordinary dividend. Its report has not yet been issued, so that the actual results of its year's trading are not known. Now, as I write, the annual report of the Park Gate Steel and Iron Company comes to hand. This firm is one of the largest engaged in the semi-finished steel trade, and produces plates for shipbuilding and other heavy purposes. For the years ended March, 1922, and March, 1923, it made heavy losses. On the present occasion, the report states that trade for the first half of the year was bad, and the works were carried on at a loss. Later, there was a slight improvement, and this, together with some changes in the organisation and the closing down of certain parts of the works, made it possible to finish the year with a small profit. This profit, however, is a mere £8100, and is arrived at without writing off anything for depreciation. It will only serve to reduce, by a fraction, the heavy debit balance of the company.

The Present Position.

Taking a general view of the situation, one is inclined to say that things are better at present than they were during the period covered by these reports, but it is well not to be too confident, and there is no great feeling of optimism abroad. There seems to be more trade about, but prices are still very low, while costs of production tend to go up. The railway departments continue to book orders, but the productive capacity has been so greatly increased of late years that work is got through in very quick time, and an enormous amount would be required to occupy them fully. A hopeful feature is the sign of improved trade at the shipyards, which should stimulate the demand for steel plates, and thus help the Sheffield district to a considerable extent. There are also evidences of progress in the textile industries, which may be expected to lead to an increased demand for machinery made of Sheffield steel. At present, it is still difficult to obtain orders for steel billets, partly owing to bad trade and partly to the arrival of foreign material, which was bought a long time ago, when prices were very low, but which has been delayed in delivery on account of the dock strike. Prices of continental steel have, however, now risen to such an extent that competition from this source is not feared at present. No weight of new business has been placed during the last month, and unless the continental position alters British billets should recover their position when the stocks now on hand are exhausted. Some indication of a better outlook is afforded by an increase in the price of heavy melting basic steel scrap, which, having been down to 87s. 6d. per ton, delivered at Sheffield works, has now recovered about 5s., although big buyers are able to arrange around 90s. The demand is reported to be broadening, and a further strengthening of the position is regarded as probable.

The Lighter Trades.

The lighter steel branches are characterised by a better tone than the heavy branches. The demand for files has improved markedly, and a larger quantity is now going out of the city than at any time last year. Excellent reports come from the saw trade, which probably never enjoyed a sounder position than it does to-day. The works are running full time, and, thanks to the superior quality of their product, the Sheffield makers have to a large extent succeeded in overcoming foreign competition in colonial markets. The cutlery trade continues in an unsatisfactory position, and electro-plate is no better. Great quantities of table cutlery, spoons and forks are produced, but they are mainly of the cheapest qualities, and prices have to be very keenly cut in order to secure the trade. The April exports of cutlery were about £12,000 in value more than those of March. An improved trade was done with South American and Scandinavian markets. Australia, though still buying largely, fell off somewhat during the month.

Colliery Progress.

Evidences of the development of the coalfield in South Yorkshire continue to accumulate. The Carlton Main Colliery Company has recently carried out many extensions, and has more in prospect. It has sunk a new shaft at Frickley, to reach the Shafton seam, and is about to install considerable equipment for the working of the coal. At the same pit, it is putting down a complete electrical generating station, with a total capacity of 18,000 kilowatts. At Grimethorpe, it is reorganising and considerably enlarging the compressing plant, in order to meet the increased demand for compressed air, which is inevitable, as the workings in the various seams increase. It also proposes to sink at Grimethorpe a completely new shaft, for the fuller development of the lower seams, and to lay down a large coking and by-product plant. At Aldwarke Main Colliery, near Rotherham, arrangements are being made for the large-scale working of the Parkgate seam, which has been proved on the low side of the Don fault. The Aldwarke plant has been completely remodelled, and the latest practice in mining engineering is being followed. Brodsworth Main, which is already one of the largest collieries in the Doncaster district, is to undergo great developments as the result of the sinking of a third shaft, which has reached the Barnsley seam at a depth of 595 yards. The new shaft will be used for the working of the Barnsley coal, and will enable the No. 2 shaft to be devoted solely to the Parkgate, which has been tapped at 814 yards, but which could not be developed until the No. 3 shaft was down to the Barnsley. A matter of great importance to the rapidly developing eastern part of the South Yorkshire coalfield is the question of future water supply, and with regard to this Mr. W. G. Fearnsides, Professor of Geology at the University of Sheffield, has been uttering a warning note. Addressing the Yorkshire branch of the Society of Medical Officers of Health, he pointed out that almost the whole of the millstone grit watershed had already been taken up by towns in the West Riding, and that there were great difficulties in the way of obtaining a supply of pure water from the coalfield itself. He advocated concerted action with the view to promoting a great scheme for piping a large supply from catchment areas in the Northern Pennines or in East Yorkshire, and advised the medical officers to interest themselves in the problem without delay.

A Local Contract.

Satisfaction is expressed at the action of the Glasgow Corporation in giving a contract for track work to Sheffield in preference to America. The Tramways Committee recommended acceptance of the tender of the United States Steel Company, but when the matter came before the full Corporation it was decided by a majority to give the work to Edgar Allen and Co., Limited, of Sheffield, whose tender was the lowest sent in from this country, but was £500 more than the American quotation.

An Electricity Success.

The annual report of the municipal electricity undertaking at Barnsley shows a very satisfactory state of affairs. The units sold, numbering 4,694,480, showed an increase of 17 per cent., but economies had been effected to such an extent that the working costs were £925 less than in the previous year. In 1912, which was the last year when the whole output was generated by reciprocating engines, the consumption of coal per unit produced was 8.58 lb.; but last year, when the whole output was generated by modern turbines and boilers, it was only 2.81 lb. The Borough Council has decided to make the following reductions in its charges:—Lighting, from 6d. to 5½d. per unit; picture palaces and theatres, from 4.5d. to 4.1d. per unit; domestic rate, from 1½d. to 1d. per unit, with an additional discount of 2½ per cent. if accounts are paid within a month. During the last five years, the price of current for lighting has been reduced from 8d. to 5½d. per unit, or 31 per cent.

NORTH OF ENGLAND.

(From our own Correspondent.)

Shipbuilding Activity.

CONDITIONS in the shipbuilding industry on the North-East Coast have undergone a vast improvement during the past few weeks, and a more hopeful view is taken of the outlook. There is greater activity at many of the yards, and a number of inquiries for new tonnage is in circulation. This week W. Gray and Co., Limited, West Hartlepool, have secured an order for a steamer of 6600 tons deadweight for London owners. Instructions have also been received by the firm to proceed with an old contract for the construction of two large cargo vessels. The Furness Shipbuilding Company, Haverton Hill, has received orders for four cargo steamers. One of them is of 10,000 tons deadweight, for Cardiff owners; one of 7500 tons, for West Hartlepool owners; and two of 2600 tons, for Middlesbrough and London owners respectively.

Cleveland Iron Trade.

Much quieter conditions prevail in the Cleveland pig iron trade. The fall of the franc has disturbed the economic equilibrium, and although continental iron is not coming across here in any quantity, French and Belgian producers are now in a position to compete with Cleveland in their own markets. Under these circumstances the foreign demand for Cleveland iron has tapered off, and with quiet conditions prevailing at home, makers are finding it a difficult matter to replace expiring contracts. However, Cleveland pig iron is still the cheapest in the country, and having already cut prices to the bone, makers are not inclined to make more than slight concessions for fresh business. For No. 3 G.M.B. Cleveland pig iron 91s. 6d. per ton has now become a fairly general quotation, although in some cases a little more is asked for f.o.b. iron. No. 1 is about 96s. 6d. to 97s., No. 4 foundry is a little easier at 90s. 6d., and No. 4 forge is 89s. 6d. to 90s. per ton.

Hematite Pig Iron.

The demand for East Coast hematite pig iron has fallen away again, and export sales in particular are very light. French hematite is now an active competitor, and prices here have weakened. For small lots of mixed numbers 98s. 6d. per ton is asked, but an order for any decent quantity can be placed at 98s. per ton.

Ironmaking Materials.

Although business in the foreign ore trade is slow in coming forward, the outlook is regarded as a little brighter, and sellers are inclined to firmness. Best Rubio ore is now quoted at 24s. per ton c.i.f. Tees. The fuel market is quiet indeed, and although sellers ask up to 28s. 6d. per ton for good medium furnace coke delivered at the works, 28s. per ton more nearly represents a market price.

Manufactured Iron and Steel.

The placing of orders for the building of several new ships at North-East Coast yards is an indication of the improved outlook in the shipbuilding industry. The improvement may only be relative, and no doubt is prompted by the desire of shipowners to acquire new tonnage before an anticipated rise in building costs takes place; but it has had the effect of stimulating the demand for steel, and specifications are coming forward more freely. In other directions the demand is quiet, and competition for foreign orders is very keen. For home business the system of fixed prices still prevails and quotations are unchanged.

The Coal Trade.

The Northern coal trade has assumed a very quiet tone. Except that there are a few fairly large contract inquiries due for consideration, the market is bare of new business, while all colliery fitters are eagerly seeking new outlet for their production. The demand during the past few days has been slow, and with the recent excitement owing to labour threats having died down, consumers are not pressing for supplies of any quantity and are mainly using up stocks, which at home ports and abroad are fairly extensive. The pressure of German coals, especially reparation supplies, is considerable in France, Belgium, and Italy, and consumers in those countries only want moderate lots of British coals for mixing purposes. The demand from those countries is therefore limited. From Germany and the Baltic ports the demand is checked by slackness of general trade combined with the high prices quoted, and consumers limit their demands to the smallest necessity. Slackness is steadily spreading throughout, and several pits are now reported idle for want of trade, while many others will have difficulty in keeping going. The prospects for the next week or two point to a slowing down of the demand, but for the summer sellers continue to take a moderately hopeful view. The scarcity of buyers, however, gives a weak tone to values, and prices, although generally quoted at late figures, are a matter of bargain. The coke trade wears a very dull appearance. There is little inquiry for early delivery and all makers complain of the lack of trade.

SCOTLAND.

(From our own Correspondent.)

The Position of Trade.

So far as the steel and iron and kindred industries are concerned the past week has brought little, if any, change. In only a few instances can it be said that works are in anything approaching a satisfactory position. The majority of establishments continue to work far below the output capacity, and no lasting improvement is looked for until the labour outlook is more settled. It is confidently believed that a considerable amount of business is being held up until such a settlement has been reached, and such belief is not without reasonable justification in view of the shipbuilding and other contracts recently reported. It has been said repeatedly that buyers await a general decrease in prices, but no movement in that direction is noticeable. In fact, the general tone throughout is firmer. Foreign offerings, which were less conspicuous recently, are once again fairly numerous, but it is said that the prices named give small inducement to purchasers. Generally speaking, the position of trade leaves much to be desired, buying on all hands being extremely slow and mostly confined to small prompt requirements. The long-desired improvement is slow to materialise, but the all-round nature of the inquiry prompts the remark that better times would quickly follow industrial peace in a labour sense, provided such a settlement held a promise of security for a considerable period.

Miscellaneous News.

It has been reported that within the past few days several important shipbuilding contracts have been placed on the Clyde. It is said that the largest order is for a 22,000-ton liner, to be built at Messrs. Beardmore's yard at Dalmuir for Italian owners. A shipbuilding firm on the lower reaches has received a contract for two new passenger-cargo vessels for an Australian concern. I understand that Henry Robb, Limited, ship repairers and engineers, Leith, have acquired one of Messrs. Hawthorn and Co.'s yards at Leith. Messrs. Robb will continue to construct dredgers and pontoons, which they formerly built at the Imperial Dock, where they had to be lowered into the water by a crane, but which they will now launch from slipways. The firm is also to build cargo vessels up to about 5000 tons. Babcock and Wilcox, Limited, have secured the contract for the boiler-house equipment, including oil storage tanks, for the electrical power-house at Cartagena, Colombia.

Steel and Iron.

Scotch steel makers report that a considerable portion of their works are still idle. The demand for sections has expanded a little, but plates of all descriptions are very quiet. Steel sheet makers are not so busy as they were a few weeks ago. Home and export inquiries, and especially the latter, are fewer, and it is said that makers are more inclined to consider offers. The demand for heavy gauges is particularly slow. Larger offerings of continental finished steel are reported. The bar ironworks are rather poorly engaged. The outlet for hoops is comparatively good, but bar iron in general shows little movement. The pig iron market is a very quiet one. The home market is particularly slow, but an expanding movement is noticeable in the export department. On occasion slightly higher prices than those ruling have been paid for hematite and foundry iron, but on the whole quotations show no alteration. The general tendency, however, is firmer.

Coal.

While business has been more or less of a restricted nature, the coal market has developed a steadier note during the past week. It would appear that buyers are becoming convinced that prices have probably reached their lowest point for the present at least. At any rate, export inquiries have been more prolific and represent likely orders from France, Italy, Spain, Denmark, and Scandinavia. Orders from Germany and France have been comparatively small of late. Screened navigation, splints, steams, and washed smalls are being inquired for. Forward business is difficult to negotiate, however, as sellers are holding out for higher prices than those quoted for prompt delivery. In the meantime the position at the collieries in all districts is unsatisfactory owing to the accumulation of loaded wagons, and idle time is fairly prevalent. The home market is comparatively idle in all branches. Developments in Lanarkshire and Ayrshire are reported, and it is expected that a number of new pits will be in operation by the autumn.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

SINCE writing a week ago, the National Executive of the Miners' Federation and the representatives of the coalowners have arrived at terms in respect of the new wages agreement, and this is regarded with some satisfaction, though so far as this district is concerned all fears of labour disturbances are not allayed. Considerable unrest appears to prevail, and it is very questionable whether the terms will meet with anything like a ready acceptance. The agreement conditions have during the past week-end been variously described by the men's leaders as the "best of a bad job" and "horribly bad," and as far as can be seen no one has come forward and really recommended the terms, or, if they have done so, they have qualified themselves by emphasising that the new agreement can only be regarded as an instalment. The extremist section in South Wales, which forms the Minority Movement, has openly declared itself as opposed to accepting the conditions, and has instructed its representatives on the National Committee of the Miners' Minority Movement to open a campaign in favour of rejecting the terms. So far as the official body is concerned, the Executive Council of the South Wales Miners' Federation has taken no definite line of policy, but has simply contented itself with calling a delegate conference for Monday next for the purpose of considering the terms and instructing its delegates to the Miners' Federation of Great Britain conference, which has been convened for the 29th inst.

Effect on the Collieries.

According to the secretary of the South Wales Coalowners' Association, the minimum under the proposed terms of settlement will, it is estimated, add between 1s. 3d. and 1s. 8d. per ton to the cost of production, whereas the profits under the last agreement in South Wales only averaged 1s. 1d. per ton. Many coalowners are undoubtedly very perturbed as to how they will be able to carry on in view of the unfavourable market conditions. Already pits have been closed, and it is feared that other owners will have to follow this course, and close down those pits which are definitely unremunerative. For instance, the Blaenavon Company, which has damped down two of its blast-furnaces during the past week-end, thus throwing out of employment 200 men for an indefinite period, has also closed the Big Pit, which means that 1400 men are affected.

Colliery Stoppages.

Trouble has again arisen at the Nine Mile Point and Risca collieries belonging to the United National Colliery Company, as a result of which about 3500 men are idle. It is understood that the real trouble centres at the Nine Mile Point Colliery, where the men downed tools because the management refused to dismiss an examiner. The miners at Risca came out in sympathy with the strikers. So far, the management has declined to discuss the men's alleged grievances until they have returned to work. About 1400 workmen engaged at the Markham Colliery, near Blackwood, belonging to the Tredegar Iron and Coal Company, refused to descend the pit on Tuesday and returned home. Their allegation was that one of their number had been victimised, which is denied by the company.

Wage Demands.

An adjourned conference, stated to represent about 10,000 hauliers, was held at Cardiff on Saturday last, when it was decided to take steps to secure the abolition of the old hauliers' agreement, and an Executive of twelve, one from each district, was appointed to draw up a new agreement. The necessity was emphasised of ensuring improved conditions of employment and of demanding a basic standard rate of 8s. 6d. per day, plus the prevailing percentages. Towards the end of last week there was also a further joint conference between the representatives of the workmen and the representatives of the Bristol Channel engineering and shipbuilding employers, with reference to the claim for an advance of wages on behalf of the general time-working trades group, but after discussion no decision was come to, except that the conference should be adjourned for a fortnight.

Current Business.

Business continues to be on the quiet side, and the demand from abroad is slow to expand. In the case of France, the fluctuation of the franc is undoubtedly hindering operations. The position of the collieries leaves much to be desired, as many pits are working very irregularly, and finding it difficult to avoid temporary stoppages. Tonnage is a little better than a week ago, the shortage being to an extent due to the action of many shipowners diverting their steamers to continental ports, because they feared a strike on the part of the trimmers and tippers as a result of the dispute at Leith. For prompt loading, the market is very uneven, and while colliery salesmen are quoting 28s. to 28s. 6d. for best Admiralty large, and are endeavouring to improve their prices in view of their extra costs under the proposed new terms with the miners, buyers are offering materially less. Outside of Admiralty coals, the demand is very meagre, this being especially the case for dry qualities and Monmouthshires. Small coals are steadier on account of the restricted supplies, as the result of the temporary stoppages which have taken place at the pits. With regard to the recent inquiry from the Egyptian State Railways, it is now reported that they have bought 150,000 tons of steam coals from this district for shipment to Alexandria between June and October inclusive. Of that quantity, it is understood that Furness, Withy and Co., Limited, have obtained 100,000 tons at 38s. 4½d., and Wm. Milburn and Co. 50,000 tons at 38s. 2d., these prices being net c.i.f. Alexandria. The Palestine Railways are also in the market for 20,000 tons of steam coals.

LAUNCHES AND TRIAL TRIPS.

TAIREA, twin-screw steamer; built by Barclay, Curle and Co., Limited, to the order of the British India Steam Navigation Company Limited; dimensions, 465ft. by 60ft. by 41ft. Engines, twin-screw, four-crank, triple-expansion; constructed by the builders; trial trip, May 5th.

COLLIER, No. 1; built by Vickers Limited, to the order of Steamships Limited, of Canada; launch, May 6th.

LORD COMBERMERE, steel screw tug and water boat; built by J. Samuel White and Co., Limited, to the order of the Crown Agents for the Colonies; dimensions, 85ft. by 20ft. by 12ft. 6in. Engines, compound steam, 11in. and 23in. diameter by 16in. stroke, pressure 140 lb.; constructed by the builders; launch, May 6th.

ARLINGTON COURT, single-screw steamer; built by Workman, Clark and Co., Limited, to the order of Haldin and Co., Limited; dimensions, 396ft. 6in. by 53ft. by 26ft. 6in.; to carry 4900 gross tonnage. Engines, surface condensing triple-expansion; constructed by the builders; trial trip, May 7th.

STOTTFOOL, single-screw steamer; built by Swan, Hunter and Wigham Richardson, Limited, to the order of T. B. Stott and Co., Limited; dimensions, 256ft. long by 32ft. 2in. broad; 2500 tons deadweight. Engines, triple-expansion; constructed by Shields Engineering and Dry Dock Company, Limited; trial trip, May 7th.

ASHTREE, steel screw steamer; built by Craig, Taylor and Co., Limited, to the order of Howard Jones, Limited; dimensions, 254ft. 9in. by 36ft. 9in. by 18ft. 1in. Engines, 19in., 31in., and 51in. by 36in., pressure 180 lb.; constructed by the North-Eastern Marine Engineering Company, Limited; trial trip, May 8th.

CITY OF HONG KONG, steamer; built by Earle's Shipbuilding and Engineering Company, Limited; to the order of Ellerman's Wilson Line, Limited; dimensions, 490ft. by 61ft. 6in. by 34ft. 9in.; to carry, 9677 gross tonnage. Engines, quadruple-expansion, 26½in., 38in., 55in. and 80in. by 54in. stroke, pressure 225 lb.; constructed by the builders; trial trip, May 15th.

AN EXHIBITION SOUVENIR.—A very charming brochure has been produced by William Beardmore and Co., Limited, as a souvenir of the Empire Exhibition. It opens with a few words about the firm, but the principal contents are admirable photogravure reproductions of six dry-point etchings by Mr. Frank H. Mason. These very effective and artistic little pictures show three views in Parkhead and three in Dalmuir. Mr. Mason has caught the spirit of his subjects very happily and, as for example in "Locomotive Building," gives a sense of grandeur and solidity with no greater departure from technical truth than engineers expect from artists.

A NEW BELT FASTENER.—A new type of belt fastener, which has just been brought out by Frys, Limited, of 46, Upper Thames-street, London, E.C. 4, consists of a single piece. It has two openings into which the ends of the belt are pushed, and the contour of the openings is such that the belt is bent backwards slightly when under tension, while their edges are serrated so as to increase the grip of the fastener. All that is necessary to remove the fastener is to bend the belt back, when the teeth will release their grip. It has the advantage that quite short pieces can be cut off the end of the belt in taking up slack, while the fastener can be used several times.

THE INSTITUTION OF CIVIL ENGINEERS.—At the annual general meeting of the Institution of Civil Engineers, held on Tuesday evening, May 13th, the result of the ballot for the election of officers was declared as follows:—President, Mr. Basil Mott, C.B. (London); vice-presidents, Sir William Henry Ellis, G.B.E., D.Eng. (Sheffield); Mr. Frederick Palmer, C.I.E. (London); Sir Archibald Denny, Bart. (London); Mr. Ernest Frederic Crosbie Trench, C.B.E. (London); other members of Council, Mr. Henry Newmarch Allott (Manchester); Mr. Albert Ashley Biggs (India); Sir John Cadman, K.C.M.G., D.Sc. (London); Sir Dugald Clerk, K.B.E., D.Sc., F.R.S. (London); Colonel Rookes Evelyn Bell Crompton, C.B., R.E. (T.), (London); Mr. Henry Albert Cutler (Ireland); Mr. William Wylie Grierson, C.B.E. (London); Sir Robert Abbott Hadfield, Bart., D.Sc., D.Met., F.R.S. (London); Sir Brodie Haldane Henderson, K.C.M.G., C.B. (London); Mr. Ernest Prescot Hill (London); Mr. George William Humphreys, C.B.E. (London); Sir Cyril Reginald Sutton Kirkpatrick (London); Sir Murdoch Macdonald, K.C.M.G., C.B. (London); Mr. John MacGlashan (India); Mr. Joseph Prime Maxwell (New Zealand); Sir Henry Percy Maybury, K.C.M.G., C.B. (London); Sir John Monash, G.C.M.G., K.C.B., D.C.L., LL.D., D.Eng. (Australia); Mr. George Taylor Nicholson (South Africa); John Bonsall Porter, Ph.D., D.Sc. (Canada); Sir Richard Augustine Studdert Redmayne, K.C.B., M.Sc. (London); Sir Hugh Reid, Bart., C.B.E., LL.D. (Glasgow); Captain Matthew Henry Phineas Riall Sankey, C.B., C.B.E., R.E. (retired) (London); Sir John Francis Cleverton Snell (London); Mr. William Archer Porter Tait, B.Sc. (London); Mr. John Duncan Watson (Birmingham); Sir Alfred Fernandez Yarrow, Bart., F.R.S. (London). This Council will take office on the first Tuesday in November, 1924.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	17/6 to 24/-
(1) Spanish	23/-
(1) N. African	23/-
N.E. COAST—	
Native	—
Foreign (c.i.f.)	23/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	5 2 6	—
No. 1 Foundry	5 5 0	—
No. 3 Foundry	5 0 0	—
N.E. COAST—		
Hematite Mixed Nos.	4 18 0	4 18 0
No. 1	4 19 0	4 19 0
Cleveland—		
No. 1	4 16 6	4 16 6
Silicious Iron	4 16 6	4 16 6
No. 3 G.M.B.	4 11 6	4 11 6
No. 4 Foundry	4 11 0	4 11 0
No. 4 Forge	4 10 0	4 10 0
Mottled	—	—
White	—	—
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	9 2 6	—
North Staffs. Forge	4 7 6 to 4 10 0	
" " Foundry	4 15 0	—
(3) Northampton—		
Foundry No. 3	4 12 6	—
" Forge	4 5 0 to 4 6 0	
(3) Derbyshire—		
No. 3 Foundry	4 14 0 to 4 15 0	
Forge	4 7 6	—
(3) Lincolnshire—		
No. 3 Foundry	4 14 6	—
No. 4 Forge	4 13 0	—
Basic	4 11 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	5 12 6 (a) / 5 17 6 (b)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	12 10 0	—
Best "	—	—
N.E. COAST—		
Common Bars	12 10 0	—
LANCS.—		
Crown Bars	13 0 0	—
Second Quality Bars	12 0 0	—
Hoops	15 0 0	14 15 0
S. YORKS.—		
Crown Bars	13 0 0	—
Best "	13 10 0	—
Hoops	14 10 0	—
MIDLANDS—		
Crown Bars	13 0 0	—
Marked Bars (Staffs.)	15 0 0	—
Nut and Bolt Bars	12 0 0	
Gas Tube Strip	13 5 0 to 13 7 6	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	13 10 0	—
Ship Plates, ½in. and up	10 5 0	—
Sections	10 0 0	—
Steel Sheets, 3/16in. to ½in.	12 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	17 10 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	10 5 0	—
Angles	10 0 0	—
Boiler Plates	13 10 0	—
Joists	10 0 0	—
Heavy Rails	9 0 0	—
Fish-plates	13 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	10 5 0	—
Soft Billets	9 0 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	9 5 0†	—
Light "	9 10 0 to 10 0 0†	
Billets	8 10 0 to 12 0 0†	
MANCHESTER—		
Bars (Round)	10 5 0 to 10 15 0	
" (others)	10 0 0 to 10 2 6	
Hoops (Best)	15 5 0	15 0 0
" (Soft Steel)	13 15 0	13 10 0
Plates	10 0 0 to 10 5 0	—
" (Lancs. Boiler)	13 10 0	—
SHEFFIELD—		
Siemens Acid Billets	12 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	10 5 0	—
Intermediate Basic	10 0 0	—
Soft Basic	8 15 0	—
Hoops	12 10 0 to 13 0 0	
Soft Wire Rods	11 0 0 to 11 10 0	
MIDLANDS—		
Small Rolled Bars	10 5 0 to 10 10 0	
Billets and Sheet-bars	8 0 0 to 8 10 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	17 0 0 to 17 5 0	
Angles	9 17 6 to 10 0 0	
Joists	9 17 6 to 10 0 0	
Tees	10 17 6 to 11 0 0	
Bridge and Tank Plates	10 10 0	—
Boiler Plates	14 0 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	23/6 to 23/9
Block Tin (cash)	201 10 0
" (three months)	201 0 0
Copper (cash)	61 15 0
" (three months)	62 12 6
Spanish Lead (cash)	28 15 0
" (three months)	27 5 0
Spelter (cash)	30 8 9
" (three months)	30 12 6
MANCHESTER—	
Copper, Best Selected Ingots	66 10 0
" Electrolytic	67 15 0
" Strong Sheets	94 0 0
" Tubes (Basis price)	0 1 1½
Brass Tubes (Basis price)	0 1 0½
" Condenser	0 1 2½
Lead, English	30 5 0
" Foreign	29 0 0

FERRO ALLOYS.

(All prices now nominal.)

Tungsten Metal Powder	1/8½ per lb.	
Ferro Tungsten	1/4½ per lb.	
	Per Ton.	Per Unit.
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 0 0	10/6
" 6 p.c. to 8 p.c. "	£23 10 0	8/-
" 8 p.c. to 10 p.c. "	£22 0 0	8/-
" Specially Refined		
" Max. 2 p.c. carbon	£42 10 0	16/-
" " 1 p.c. "	£51 0 0	17/6
" " 0.75 p.c. carbon	£75 0 0	20/-
" carbon free	1/5 per lb.	
Metallic Chromium	4/2 per lb.	
Ferro Manganese (per ton)	£17 for home, £17 for export	
" Silicon, 45 p.c. to 50 p.c.	£11 10 0 scale 5/- per unit	
" " 75 p.c.	£18 0 0 scale 6/- per unit	
" Vanadium	19/9 per lb.	
" Molybdenum	8/6 per lb.	
" Titanium (carbon free)	1/3 per lb.	
Nickel (per ton)	£135	
Cobalt	10/6 per lb.	
Aluminium (per ton)	£82 to £100 (British Official.)	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	20/-
" " Ell	21/6
" " Splint	22/- to 24/-
" " Trebles	22/-
" " Doubles	21/-
" " Singles	18/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	20/-
" " Splint	22/-
" " Trebles	22/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	19/6 to 22/9
Screened Navigation	27/6
Trebles	22/-
Doubles	21/-
Singles	18/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	21/-
Secondary Steam	20/-
Trebles	22/-
Doubles	22/3
Singles	18/-

ENGLAND.

(8) N.W. COAST—	
Steams	32/-
Household	49/- to 59/-
Coke	35/-
NORTHUMBERLAND—	
Best Steams	23/-
Second Steams	21/- to 21/6
Steam Smalls	14/- to 14/6
Unscreened	18/- to 20/-
Household	27/-
DURHAM—	
Best Gas	23/6 to 24/-
Second	21/-
Household	27/-
Foundry Coke	26/- to 28/-
SHEFFIELD—	Inland.
Best Hand-picked Branch	34/- to 37/- —
Barnsley Best Silkstone	31/6 to 32/6 —
Derbyshire Best Brights	29/- to 31/6 —
" " House	26/- to 28/- —
" " Large Nuts	24/- to 25/- —
" " Small "	18/6 to 20/6 —
Yorkshire Hards	24/6 to 25/6 —
Derbyshire "	22/- to 24/- —
Rough Slacks	12/6 to 15/6 —
Nutty "	12/- to 14/- —
Smalls	8/- to 10/- —
Blast-furnace Coke (Inland) *	
" " (Export)	f.o.b. 30

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	28/- to 28/6
Second " "	27/- to 27/6
Best Dry Large	27/- to 27/6
Ordinary Dry Large	25/6 to 26/6
Best Black Vein Large	26/6 to 27/-
Western Valley "	26/- to 26/6
Best Eastern Valley Large	25/- to 26/-
Ordinary " "	24/- to 25/-
Best Steam Smalls	18/- to 19/-
Ordinary "	16/6 to 18/-
Washed Nuts	25/- to 27/-
No. 3 Rhondda Large	28/- to 29/-
" " Smalls	24/- to 25/-
No. 2 " Large	24/6 to 25/6
" " Through	21/- to 23/-
" " Smalls	16/- to 17/-
Coke (export)	50/- to 57/6
Patent Fuel	29/- to 30/-
Pitwood (ex ship)	29/- to 30/-
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	47/6 to 50/-
Seconds	40/- to 42/6
Red Vein	32/6 to 35/-
Machine-made Cobbles	52/6 to 57/6
Nuts	45/- to 55/-
Beans	45/- to 47/6
Peas	27/- to 29/-
Breaker Duff	11/3 to 11/6
Rubbly Culm	16/- to 16/6
Steam Coals:	
Large	24/- to 26/-
Seconds	22/- to 24/-
Smalls	15/- to 18/-
Cargo Through	18/- to 22/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow.

(8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

* Blast-furnace Coke (Inland): Special Price for Ironworks 23/-, open market 28/-. † Latest quotations available. (a) Delivered Sheffield or Glasgow. (b) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

The Trade Future.

THE unexpected reversal of the political situation has had the effect of accentuating still further the feeling of indecision that has for some time past pervaded all departments of industry. The falling off in business activity is so pronounced that there is very little being done at the present moment, and no recovery can be looked for until something definite is known of the trend of future events. The factors that have favourably influenced the iron, steel, and engineering trades are the supplies of cheap fuel from the Ruhr and the increased duties on imported products and goods. So long as France remains in the Ruhr and is able to ensure supplies of coke and coal the iron and steel producers can increase their output and diminish costs to the extent that with the franc at its present low level they seem to be in a fair way to control foreign markets. It is true that even the occupation does not guarantee supplies, for, on account of the strikes in the Ruhr, the consignments of coke last month declined by 50 per cent., but the French fear that if they leave the territory they will have no guarantee at all, and the situation of the Lorraine blast-furnace proprietors will become extremely critical. In the same way, it is declared that any change in the fiscal arrangements will have serious consequences for the manufacturing industries. Until, therefore, something is known of the intentions of the future Government there can be little hope of business recovery, and the situation is likely to remain unsatisfactory for another two weeks at least.

International Fairs.

The increasing number of commercial and industrial fairs that have been organised on the Continent during the past five or six years offers abundant proof of the popularity of these "sample" exhibitions. At the same time their multiplicity is causing a good deal of embarrassment to manufacturers, and the expense involved in taking part in so many is likely to defeat the ends for which the fairs were established. During the past week delegates from all the principal international fairs in Europe, including Great Britain, met in Paris under the auspices of the International Chamber of Commerce to decide upon the measures to be taken to restrict the number of these exhibitions. Amongst the proposals made at the meeting was one to the effect that the Governments of different countries should only give support to fairs of an international character. At the same time the dates are to be arranged to prevent any clashing of fairs, and specially reduced charges for the transport of goods to be exhibited, as well as for visitors are to be sought for.

The Paris Fair.

The Paris Fair, which has always been devoted exclusively to French products, shows a tendency to become international in character. For the first time Belgian firms have been admitted, and if their participation had been at all adequate it is difficult to see where they could have been placed, for the Champ de Mars, vast as it is, is barely sufficient for the exhibitors, who are increasing considerably in numbers every year. The Paris Fair covers all the national and colonial industries, and it is obvious that there can be no hope of its becoming international until the special exhibition grounds are available at the Porte de Versailles, but as no progress seems to be made with this project, mainly on account of financial difficulties, the Exhibition is likely to remain national for a long while to come, with a limited Belgian participation. As it is, the Fair offers only a moderate interest to the engineer, for the reason that the metallurgical and mechanical and electrical engineering exhibits are crowded in one building, and in the absence of nearly all the leading firms, which could not do justice to themselves in the space allotted, the Fair is not representative of the national industry. The most noteworthy exhibits are those relating to woodworking machinery and machine tools, in which the French have made great strides; but there is little shown which indicates any practical departure in design and construction. Favoured by the low value of the franc and the high import duties, makers have been able to secure the whole of the home trade in these classes of machinery, and the development of this branch of the manufacturing industry is shown by the presence of several new exhibitors at the Fair. At a time when building activity is struggling with high prices, quite a large part of the Champ de Mars is devoted to different methods of building construction, either in wood or composite material, and one of the most interesting of these is the utilisation of straw, which is hydraulically pressed and wire bound in the form of slabs and covered with cement. The material is claimed to be fireproof and to be a non-conductor of heat, cold and sound. The agricultural machinery section is fairly extensive and is fully representative of the French industry.

Paris Streets.

Close upon a million square metres of streets in Paris are to be repaved this year and more than a third of that area will be in asphalt, which is found to be more economical than wood or granite on account of the facility with which it can be repaired. Increasing preference is shown for this material on fairly level roads, and it is steadily replacing granite setts, which are now employed mainly in the form of small blocks reduced from the old ones and laid like a mosaic, fan shaped. This makes an excellent surface for ordinary traffic, but on account of the lightness of the blocks is not suitable where the traffic is particularly heavy. The maintenance of wood pavement is so costly to the municipality that an experiment is to be made of giving out a contract for certain streets to a private firm, which will put down the paving and keep it in good condition at a fixed price for a period of fifteen years. It is believed that a private firm will be able to do this much more economically than the municipality.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

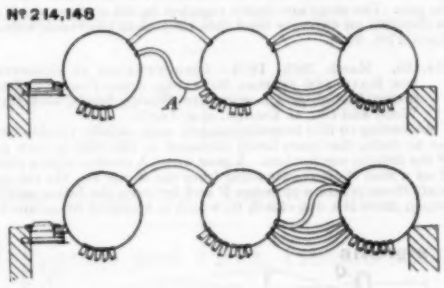
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

214,148. August 1st, 1923.—WATER-TUBE BOILERS, The Stirling Boiler Company, Limited, 54, Victoria-street, Westminster, and H. J. S. Mackay, Rosemount, Bellevue-road, Ryde, Isle of Wight.

The inventors claim that their arrangement of connecting tubes prevents priming in the boiler if the water contains sub-

Nº 214,148



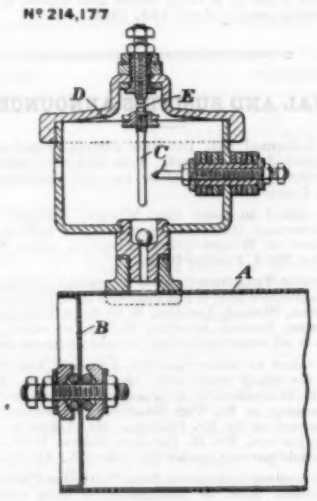
stances, such as magnesium compounds, which tend to froth. The connecting tubes A are so bent that they start from well below the water level in one drum and deliver well above that level in the drum from which the steam is drawn; but it appears from several alternative sketches that it is not necessary for all the tubes to be S-shaped.—*April 17th*, 1924.

BATTERIES AND ACCUMULATORS.

214,177. March 17th, 1923.—IMPROVEMENTS IN OR RELATING TO ELECTRIC STORAGE BATTERIES, John Ferreal Monnot, of Highwood House, Mill Hill.

This invention relates more particularly to storage batteries in which nickel paste is used for the active material. In nickel secondary batteries the electrolyte usually consists of a solution of caustic potash, and if this electrolyte be exposed to the air it must be renewed at frequent intervals. Moreover, whilst the cells are charging, a considerable proportion of the water is

Nº 214,177



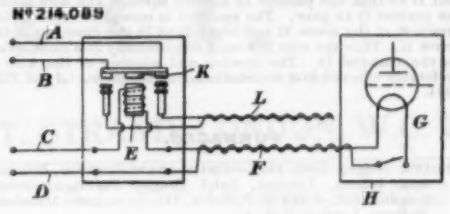
decomposed into oxygen and hydrogen and the addition of water is necessary. According to this invention the casing A of the cell is provided with a sealed cover B. Attached to this casing there is an ignition chamber, in which there are sparking electrodes C. When the pressure rises to a predetermined value the diaphragm D closes the contacts E and ignition occurs across the contacts C. Any mixture of oxygen and hydrogen will therefore be ignited and re-combined into water which is returned to the cell.—*April 17th*, 1924.

TELEGRAPHS AND TELEPHONES.

214,089. April 26th, 1923.—IMPROVEMENTS IN THE ARRANGEMENTS FOR THE SUPPLY OF POWER TO WIRELESS TRANSMITTERS, Kenneth Essex Edgeworth, The Signal Experimental Establishment, Woolwich.

In small wireless stations in which a transmitter and receiver are placed close together and worked alternately it is found that the induction from the high-pressure power cable may interfere with the action of the receiver, and the object of this invention is to overcome this difficulty. In the diagram A and B are the high-pressure leads from the generator, and C and D the low-pressure leads. K is the armature of a relay and L is the high-pressure circuit. It will be seen that the low-pressure leads are connected to the relay magnet E and thence through the low-pressure cable F to the tranamitter G, where the circuit is completed through the switch H and the filament of the valve. When the switch H is closed the magnet E is energised and the high-pressure circuit is closed. Current at a high pressure will therefore be applied to the high-pressure cable L, but only when current is passing through the valve filament. When the transmitter is not working the low-pressure cable between the power switchboard and the transmitter is "live," but the high-pressure cable is not. When the operator switches on the current to the filament the device comes into action and switches on the high-pressure current and thus enables the transmitter to be operated. Moreover, when the operator switches off the low-pressure current

Nº 214,089



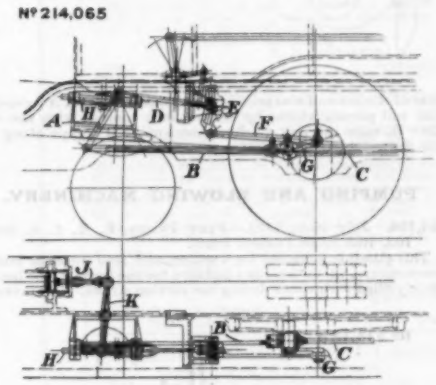
at the conclusion of the transmission the device again acts and breaks the high-pressure supply at the switchboard.—*April 17th*, 1924.

LOCOMOTIVES.

214,065. March 22nd, 1923.—VALVE GEAR, H. P. M. Beames, Chester-place, Crewe.

This gear is a modification of the Walschaerts type and is shown applied to an inside cylinder engine. The combining lever A is driven, through a link B, from an extension on the

Nº 214,065



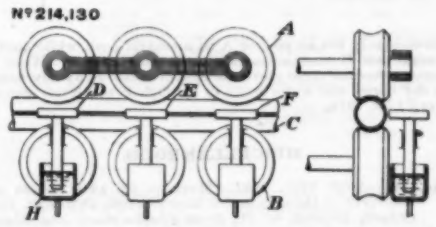
coupling-rod C and also through the usual link D, expansion link E and connecting-rod F by a return crank G on the coupling-rod crank pin. The combining lever operates a guide spindle H, which in turn works the valve spindle J through the rocking lever K.—*April 17th*, 1924.

MACHINE TOOLS AND SHOP APPLIANCES.

214,130. June 27th, 1923.—IMPROVEMENTS IN AND RELATING TO ELECTRIC TUBE WELDING MACHINES, Edmund Schröder, of Maybach-ufer 48-51, Berlin.

In the electric tube welding machine described in this specification two groups of pressure rollers A and B work together and compress the tube C, whilst the electrodes D E F form the poles

Nº 214,130



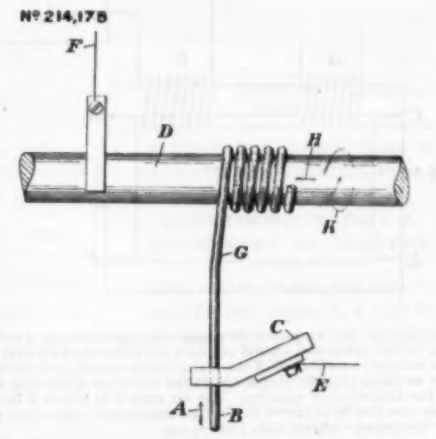
of a transformer (not shown) and perform the welding operation. Three rollers can form the three free poles of a three-phase transformer connected star fashion, so that the tube serves as a short-circuiting conductor. For cooling the rollers D E F water troughs H are provided.—*April 17th*, 1924.

LIGHTING AND HEATING.

214,175. November 20th, 1923.—IMPROVEMENTS IN THE MANUFACTURE OF SPIRAL FILAMENTS OF REFRACTORY METALS FOR INCANDESCENT ELECTRIC LAMPS, *The General Electric Company, of Magnet House, W.C. 2.*

The object of this invention is to simplify the preparation of

Nº 214,175



spiral filaments of refractory metals, such as tungsten, consisting of long crystals, and at the same time to produce a better crystal structure than that which is obtained by other pro-

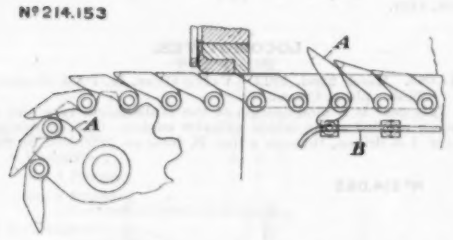
cesses. In the diagram the arrow A indicates the direction of travel of the tungsten wire B, which, after passing a contact C, is wound on a mandrel D. The contact C may consist of mercury. Leads E and F are connected with the contact C and the mandrel D so that the passage of current through the wire causes the portion G to glow. The mandrel is moved forward in the direction of the arrow H and is revolved in the direction of the arrow K. Thus the wire is wound continuously in a close spiral on the mandrel D. The heating and winding of the wire is preferably effected in a non-oxidising atmosphere.—*April 17th*, 1924.

FURNACES.

214,153. August 15th, 1923.—CHAIN-GRATE STOKERS, Babcock and Wilcox, Limited, Oriel House, Farringdon-street, London, E.C. 4, and H. P. Smith, 14A, Boundaries Mansions, Balham, London, S.W. 12.

This invention is intended to keep the side wall of the furnace

Nº 214,153



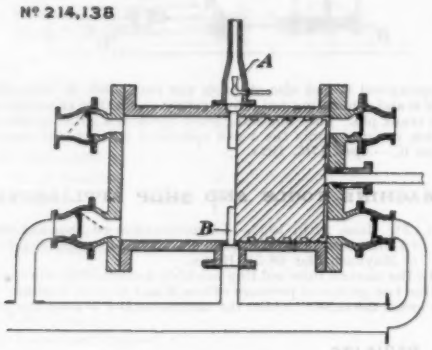
clear of clinker and comprises a set of special links A A furnished with tail pieces, which, by coming into contact with the cam plate B, raise the link as shown and make it scrape along the side wall.—*April 17th*, 1924.

PUMPING AND BLOWING MACHINERY.

214,138. July 16th, 1923.—FEED PUMPS, F. X. J. A. Delas, 103, Rue Saint-Lazare, Paris.

This pump is intended for working with feed water at boiling temperature, when there is a liability for the barrel to be incompletely filled with water during the suction stroke. The inventor

Nº 214,138



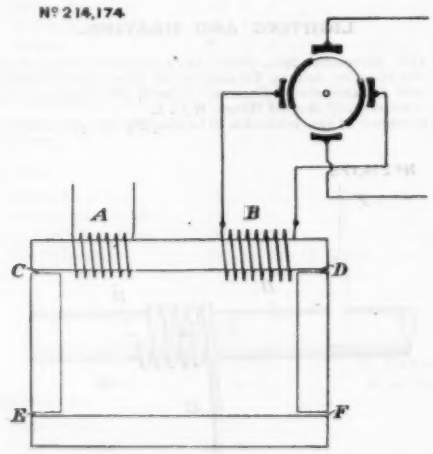
consequently fits an ejector A to a central port, while another central port B communicates with the suction pipe. When the piston overruns these ports the ejector clears away any vapour in the barrel and water flows in through B to fill the space.—*April 17th*, 1924.

MISCELLANEOUS.

214,174. April 17th, 1924.—METHOD OF AND MEANS FOR RECTIFYING HIGH-TENSION ALTERNATING CURRENT, *Lodge Cottrell, Limited, of 51, Great Charles-street, and Church-street, Birmingham.*

When high-tension alternating current is rectified by means of mechanical rectifiers, cathode, tubes, &c., excess voltages are frequently set up and produce extreme electrical stresses in the rectifier and in other parts of the installation, and may give rise

Nº 214,174

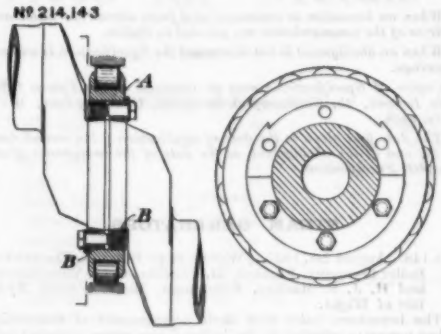


to "flash overs" at the rectifier and in the transformer. According to this invention, excess voltages are eliminated by varying the inductive resistance of the high-tension transformer feeding the rectifier. In the diagram A is the low-tension winding and B the high-tension winding. The air gaps C D E and F in the iron core can be adjusted so that the resonance conductions can be destroyed.—*April 17th*, 1924.

214,143. July 26th, 1923.—CRANE PIN BEARINGS, G. S. Wilkinson, 211, Acton Vale, London, W. 3, and M. S. Napier, Villa des Cistes, Chemin du Roi Albert, Cannes, France.

This invention relates to roller crank pin bearings. The inner race A of the bearing is of such a diameter that it can be threaded over the crank webs into place. The space between it and the crank pin is then filled by two rings B B, each in halves, which

Nº 214,143

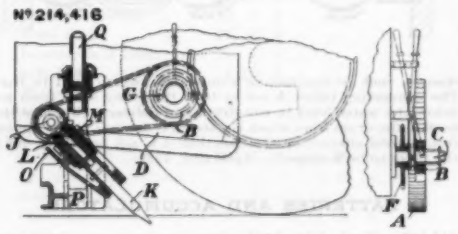


have coned internal faces to correspond with conical faces on the pin. The rings are drawn together by set screws, which are so disposed on opposite sides that they clear the crank webs.—*April 17th*, 1924.

214,416. March 20th, 1923.—IMPROVEMENTS IN SCARIFIERS FOR ROAD AND SIMILAR SURFACES, John Fowler and Co., Steam Plough and Locomotive Works, Leeds, and David Wood and Co., of Yeadon, near Leeds.

According to this invention one or more axially rotable tynes act as drills, the tynes being mounted on the vehicle with part of the driving mechanism. A gear wheel A meshes with a pinion B on a stub shaft C extending from the frame D. On the stub shaft there is also a sprocket F and between the latter and the pinion there is a dog clutch G, which is operated by means of a

Nº 214,416



fork and handle so that the drive to the sprocket can be put in and out of action at will. The sprocket F is connected by a chain to another sprocket mounted on the stub shaft J. In this way power is supplied to the tynes K through the bevel wheel L. When two or more tynes are provided the rotation of one is imparted to the next in the opposite direction by means of intermeshing spur wheels M. The tynes can be raised or lowered at will by the member O, which is mounted in a bracket P, the complete unit being operated by a screw spindle Q and a nut made in the form of a bevel wheel and driven by any convenient arrangement.—*April 24th*, 1924.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

WE are informed that the Star Contra-Propeller Company has appointed James Pollock, Sons and Co., Limited, of 3, Lloyd's-avenue, London, E.C. 3, its sole concessionaires for the British Empire.

WE are asked to state that Winget, Limited, of Winget House, Grosvenor Gardens, Westminster, S.W. 1, has been reconstructed as Winget (1924) Limited, under the control of its founder, Mr. J. Faulder Burn.

THE LONDON TELEPHONE (NEW SYSTEM) COMPANY, Limited, asks us to announce that it has removed from Donington House, Norfolk-street, Strand, London, W.C. 2, to Effingham House, Arundel-street, Strand, London, W.C. 2, to which address it requests that all communications should in future be sent.

WE are asked to state that Mr. Leonard Askew, who was associated for many years with the late Mr. A. F. Phillips, M. Inst. C.E., is continuing the practice in gas, water and general civil engineering at 82, Victoria-street, Westminster, S.W. 1, formerly carried on by Mr. Phillips. Mr. Askew is taking into partnership his son, Mr. H. Royston Askew, B.Sc., A.M. Inst. C.E., as his sole partner, under the title of L. Askew and Son.

WE have received intimation from Tully Gas Plants, Limited, that consequent upon its amalgamation with Gas and Fuel Plants, Limited, the company has gone into voluntary liquidation. The business will, in future, be carried on by Gas and Fuel Plants, Limited, which owns construction rights for plants for the production of smokeless fuel. The registered office of Gas and Fuel Plants, Limited, is 40–3, Norfolk-street, Strand, London, W.C. 2, the telegraphic address is "Damper, Estrand, London," and the telephone numbers are City 4047 and 4048.

WE are informed by Mr. Geo. V. Twiss, M.I.E.E., that as from December 31st last he has relinquished his position of consulting director of the Twiss Electric Transmission, Limited, and has also resigned his seat on the board and completely severed his connection with that company, in order to devote himself exclusively to his consulting practice at his office at Broad Sanctuary Chambers, 11, Tothill-street, Westminster. He has also taken into partnership Mr. J. N. R. Perks, M.A. (Cantab), A.M.I.E.E., and the style of the firm will from now onwards be G. V. Twiss and Co.

EXHIBITION OF ARCHITECTURE, WEMBLEY.—The exhibition of modern British architecture, which has been arranged by the Royal Institute of British Architects and the Architecture Club, will be opened by the Earl of Crawford and Balcarres on Monday, May 26th, 1924, at 3 p.m. in the Short Period Rooms, Palace of Arts, British Empire Exhibition, Wembley.

KELVIN CENTENARY.—The members of the Kelvin Masonic Lodge, No. 3736, will hold a special centenary meeting on June 20th, in order to commemorate the birth on June 26th, 1824, of William Thomson, Lord Kelvin, and we are asked to state that the Worshipful Master and brethren of the lodge will be pleased to welcome all those who would like to associate themselves with the celebration. Full particulars may be obtained from the secretary, Mr. H. W. S. Rentell, 36, Maiden-lane, London, W.C. 2.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, London, W. 1. Discourse, "Historical Aspects of Malaria," by Dr. Andrew Balfour. 9 p.m.

SATURDAY, MAY 24TH.

INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—Visit to South Staffordshire Waterworks. 11 a.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Southern District meeting at Abingdon. 10.30 a.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—The Guildhall, York. Yorkshire District meeting. 2.30 p.m.

MONDAY, MAY 26TH.

SURVEYORS' INSTITUTION.—12, Great George-street, Westminster, London, S.W. 1. Annual general meeting. 5 p.m.

TUESDAY, MAY 27TH.

SOCIETY OF GLASS TECHNOLOGY.—Hotel Cecil, Strand, London, W.C. 2. Annual dinner. 7 for 7.15 p.m.

WEDNESDAY, MAY 28TH.

RADIO SOCIETY OF GREAT BRITAIN.—Institution of Electrical Engineers, Savoy-place, London, W.C. 2. "Wireless in British Military Aircraft up to August, 1914." 6 p.m.

THURSDAY, MAY 29TH.

MANCHESTER ASSOCIATION OF ENGINEERS.—Visit to the works of the Vulcan Foundry Company, Limited.

ROYAL AERONAUTICAL SOCIETY.—Royal Society of Arts, 18, John-street, Adelphi. The Wilbur Wright Lecture, entitled "Fuel Economy in Flight," will be delivered by Colonel H. T. Tizard, A.F.C. 8.30 p.m.

ROYAL AUTOMOBILE CLUB.—The annual general meeting of the R.A.C. will be held at the Club on Thursday, May 29th, at 2.30 p.m.

THURSDAY TO SATURDAY, MAY 29TH TO 31ST.

INSTITUTE OF TRANSPORT.—Congress at Bristol. For programme, see page 478.

FRIDAY, MAY 30TH.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Discourse, "Recent Developments in High-speed Cinematography," by Monsieur Lucien Bull. 9 p.m.

MONDAY, JUNE 2ND.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Royal Automobile Club, Pall Mall, London, S.W. 1. Dinner to celebrate Colonel Crompton's eightieth birthday. 7.30 p.m.

TUESDAY TO FRIDAY, JUNE 3RD TO 6TH.

EMPIRE MINING AND METALLURGICAL CONGRESS.—At the British Empire Exhibition, Wembley. For programme see page 508.

WEDNESDAY, JUNE 4TH.

INSTITUTE OF METALS.—Institution of Mechanical Engineers, Storey's-gate, Westminster, London, S.W. 1. Fourteenth annual May Lecture on "Atoms and Isotopes," by Dr. F. W. Aston, F.R.S. 8 p.m.

WEDNESDAY AND THURSDAY, JUNE 18TH AND 19TH.

NEWCOMEN SOCIETY.—Summer meeting at Shrewsbury.

CONTRACTS.

HOLLINGS AND GUEST, Limited, of Thimble Mill-lane, Birmingham, have received an order for a set of heavy sludge pumps for the Saltley drainage works, similar to that supplied last year to the Birmingham Tame and Rea District Drainage Board. The pump is to be of the three-throw single-acting piston type, having three pistons, and capable of pumping 500 gallons of sewage sludge per minute when delivering, and 1000 gallons of sewage sludge per minute when circulating.

CONFERENCE ON SCIENCE AND LABOUR.—The programme of the Conference on Science and Labour to be held at the British Empire Exhibition on May 30th and 31st has been published. The Conference has been arranged by the British Science Guild, in co-operation with the National Joint Council of the Trades Union Congress and the Labour Party. There are to be five sessions. The subjects brought forward for discussion will be as follows:—(1) The Place of Science in Government; (2) Scientific Research in relation to Industry; (3) Co-operation of Science and Labour in Production; (4) Science and the Human Factor; (5) Science in Educational Organisation. The Prime Minister will open the Conference. Sir Richard Gregory will preside, and Mr. Sidney Webb, President of the Board of Trade, will open the discussion on Science in Government, and Sir Richard Glazebrook and Major Church will speak. At the second session Lord Askwith will preside, and the chief speakers will be Mr. Hugo Hirst, Sir Oliver Lodge, Sir Daniel Hall, and Mr. A. P. M. Fleming. Mr. C. T. Cramp will preside at the discussion on Science and Production, and the speakers are Lord Ashfield, Sir Hugh Bell, Mr. Frank Varley, and Mr. W. Straker. The fourth meeting will deal with Health and Psychology. Miss Margaret Bondfield will preside, and the speakers include Sir Arthur Newsholme, Dr. C. S. Myers, Dr. Cyril Burt, and Miss May Smith. At the final session, Mr. Arthur Greenwood will preside, and the discussion on Science in Educational Organisation will be opened by Mr. R. H. Tawney, who will be followed by Sir Thomas Holland and Dr. R. P. Scott. Copies of the programme and tickets of admission may be obtained by application to the Conference Secretary, 15, Gower-street, W.C. 1.